DOCUMENT RESUME

ED 372 299 CE 066 944

TITLE ABE Math Standards Project. Formative Evaluation Report.
INSTITUTION Holyoke Community Coll., MA.
SPONS AGENCY National Inst. for Literacy, Washington, DC.
PUB DATE 94
NOTE 80p.; For related documents, see CE 066 942-943.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Academic Standards; *Adult Basic Education; Curriculum Development; High School Equivalency Programs; Material Development; Mathematics Instruction; *Mathematics Teachers; *Newsletters; Program Effectiveness; *Staff Development; *Statewide Planning; Teacher Attitudes; Teacher Improvement; *Teamwork
IDENTIFIERS *Massachusetts; NCTM Curriculum and Evaluation Standards; NCTM Professional Teaching Standards

ABSTRACT

In May 1992, 22 Massachusetts mathematics educators who either teach or coordinate/direct adult basic education (ABE) and General Educational Development (GED) programs were recruited into a group called the Math Team. During their monthly business/training sessions in central Massachusetts, members worked on various individual and team activities, including review and adaptation of the National Council of Teachers of Mathematics (NCTM) standards for adult learning environments and production of newsletter for adult educators called "The Problem Solver." Team members were interviewed during the eighth month of the yearlong project to determine their attitudes toward the Math Team's operation and effectiveness as a staff development activity. Interviewees credited the Math Team with improving their understanding of mathematics and ability to reach students, helping them gain energy and motivation from other team members, and improving their ability to teach other subjects besides mathematics. The team's limited membership and the fact that team members receive monetary compensation for their participation were cited as factors contributing to its effectiveness as a staff development tool. (Attached are the first three issues of "The Problem Solver," which contain information on NCTM standards and their revision, sample curricula, teaching materials, reviews, and announcements of upcoming events.) (MN)

***********************************************************************
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
***********************************************************************

ED 372 299

# ABE Math Standards Project

## Formative Evaluation Report

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

CE066944

BEST COPY AVAILABLE

## PROJECT OVERVIEW

### THE CONTEXT

The ABE Math Standards Project should be seen within the context of two broad-based reform movements. The first is the reform of mathematics education that is led by the National Council of Teachers of Mathematics. Often referred to as "the Standards," NCTM released two documents, one on curriculum standards (1989) and one on professional teaching standards (1991) which have been instrumental in changing the complexion of mathematics learning and teaching in grades K-12. In April, 1990, a small group of adult basic educators issued a "Call for Action" to NCTM asking the organization to "extend its agenda to adult learners." NCTM responded by setting up exploratory task forces, and co-sponsored a March, 1994, "Conference on Adult Mathematical Literacy." The ABE Math Standards Project was presented at the conference as a case study of how the NCTM Standards was successfully adapted to adult learning environments.

The second reform movement is the support to adult basic education that was set in motion by the National Literacy Act of 1991. The Act's expanded definition of literacy included acquisition of computation and problem-solving skills. In addition, it created the National Institute for Literacy and state literacy resource centers and required that states increase their minimum contribution to teacher development. These structures provide an atmosphere that supports projects that aim to improve the quality of education for adults, in this case numeracy education. The ABE Math Standards Project is an early example of how these supports can enable grass-roots reform efforts.

Indeed, the ABE Math Standards Project represents a significant effort to coalesce the efforts of the NCTM with the National Literacy Act.

### NOTICEABLE OBSERVATIONS

The ABE Math Standards Projects was intended to examine the NCTM standards, to initiate an adaptation of math standards appropriate for the ABE classroom, and to provide the opportunity for a small group of teachers to experience implementing those standards while reflecting on their practice.

As a result, the "real" major findings are described through the teachers' and students' words in Volumes I and II. However, the following points about the content and process of the project are significant observations that were important to our learning and moving forward:

1. The NCTM Standards' philosophy applies well to adults; however, the developmental levels and the language of the NCTM Standards needed to be translated into rationales, applications, and examples which connected to adult learning.

   In addition, the NCTM Standards put forth four overarching principles for mathematics instruction for children which apply equally to adult learning environments: (a) Mathematics as problem-solving; (b) mathematics as communication; (c) mathematical reasoning; and (d) mathematical connections. We note that the second volume, on research, is organized according to these four "process standards."

2. Although there are unique constraints involved with adult learning of mathematics, we found many commonalities amongst the groups within adult basic education (ABE, ESL, GED, and Workplace Education). For this reason, we put forth a set of twelve standards which apply to all adult learners regardless of their classification. We noted in the text where there were differences.

   STANDARD 1: MATHEMATICS AS PROBLEM SOLVING
   STANDARD 2: MATHEMATICS AS COMMUNICATION
   STANDARD 3: MATHEMATICS AS REASONING
   STANDARD 4: MATHEMATICAL CONNECTIONS
   STANDARD 5: ESTIMATION
   STANDARD 6: NUMBERS, OPERATIONS, AND COMPUTATION
   STANDARD 7: PATTERNS, RELATIONSHIPS, AND FUNCTIONS
   STANDARD 8: ALGEBRA
   STANDARD 9: STATISTICS AND PROBABILITY
   STANDARD 10: GEOMETRY AND SPATIAL SENSE
   STANDARD 11: MEASUREMENT
   STANDARD 12: EVALUATION AND ASSESSMENT

3. Teacher research through inquiry was a powerful tool for professional development, especially for experienced teachers. It was the research stance which gave teachers permission to explore, rethink, and reform their practices. Teachers were motivated to change their practices as a result of their own ideas, questions, and reflection. This inquiry process became a tool which some teachers used to transform the way they taught other content areas, not just math.

4. When adult learners were engaged as co-researchers and not merely "observed," the teaching and learning process became fused and the relationship between the teacher and student became one of discovery and constructing meaning together.

   Teacher networks not only provided means of communication that expanded the knowledge base of information and ideas, but also provided support for the risk-taking needed for personal and professional reform. These networks produced collaborations that supported growth and alleviated the restrictions of isolation.

5. Although the majority of teachers on the team had not been trained to teach math (quite like most mathematics teachers in adult education), these teachers developed as leaders of mathematics among Massachusetts teachers within a relatively short period of time as a result of self-motivation and the proper opportunity for professional development.

## ADDITIONAL ACTIVITIES OF THE ABE MATH STANDARDS PROJECT

Throughout the year, the Massachusetts ABE Math Team has tried to raise awareness with colleagues in our programs, state and in other states through "hands-on" workshops, presentations, and printed material.

### WRITTEN MATERIAL

- Publication of *The Problem Solver*, a statewide newsletter on math for adult basic education teachers and learners. (three issues)

- Contributions to :

  The Texas statewide adult education newsletter

  The GEDTS national newsletter

  The Action Research File on mathematics, published by Dr. Mezirow, New York, New York

## PRESENTATIONS

- Washington State (ABLE) Summer Institute, August, 1993
- Wisconsin State Adult Education Conference, October, 1993
- OERI, Washington, DC, June, 1993
- Mountain Plains Annual Adult Education Conference, April, 1993
- KET TV Professional Development Teleconference (tape available) October, 1993
- Ethnography Conference, Philadelphia, PA, February, 1994
- International Reading Association Annual Conference, January, 1994
- Network '93, Massachusetts' annual ABE conference, October, 1993
- AAACE, Dallas, TX, November, 1993
- Conference on Adult Mathematical Literacy, Arlington, VA, March, 1994
- New Hampshire State Meeting, April, 1994
- NCTM Research Pre-conference, April, 1994

SLATED:

- Adult Learning Disabilities Conference, Connecticut, June, 1994

Judith Francis, SABES Evaluation Consultant

# SABES Evaluation
# Western Region
# Math Team

## CONTENTS

I. The Math Team -- Overview . . . . . . . . . . . . . . . . . . . . . . . . 1

II. Impact of the Math Team . . . . . . . . . . . . . . . . . . . . . . . . 2
  Vignette -- A Math Class . . . . . . . . . . . . . . . . . . . . . . . . 3
  Vignette -- Looking at Learning and Teaching . . . . . . . . . . . . . . 3
  Vignette -- Individual/Professional Growth . . . . . . . . . . . . . . . 3
  Reaching Students . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4
  Sharing ideas with Team Members . . . . . . . . . . . . . . . . . . . . . 5
  Teaching Other Subjects . . . . . . . . . . . . . . . . . . . . . . . . . 6
  Sharing with Other Colleagues . . . . . . . . . . . . . . . . . . . . . . 7
  Accomplishments: Individual Perspectives . . . . . . . . . . . . . . . . 8

III. Process: What has worked? . . . . . . . . . . . . . . . . . . . . . . . 9
  Staying on the Team -- Motivation . . . . . . . . . . . . . . . . . . . . 9
    Compensation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10
    Limiting the Group Size/Membership . . . . . . . . . . . . . . . . . . 11
    Professional Challenges . . . . . . . . . . . . . . . . . . . . . . . . 11
    Responsibility to the Group . . . . . . . . . . . . . . . . . . . . . . 12
  Crucial Elements of the Math Team . . . . . . . . . . . . . . . . . . . . 12
    "Talking Math" . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13
    Having Fun . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14
    Teamwork, Leadership, Support . . . . . . . . . . . . . . . . . . . . . 15

IV. The Structure: How have team members responded? . . . . . . . . . . . . 15
    The Work Groups . . . . . . . . . . . . . . . . . . . . . . . . . . . . 16
    Large Group-Team Meetings . . . . . . . . . . . . . . . . . . . . . . . 18
    Retreat . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 21
    Mathnet . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 22

V. Tasks . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 23
    Adapting the Standards . . . . . . . . . . . . . . . . . . . . . . . . 23
    Projects . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 25
    Vignette - Journal Writing in a Math Class . . . . . . . . . . . . . . 27
    Observation/Reflection . . . . . . . . . . . . . . . . . . . . . . . . 27
    Conflicts - Time and Program Requirements . . . . . . . . . . . . . . . 28

VI. The Math Team as Staff Development . . . . . . . . . . . . . . . . . . . 29

V. "Next Steps" -- Recommendations of Participants . . . . . . . . . . . . . 32

Judith Francis, SABES Evaluation Consultant

# SABES Western Region
# Evaluation 1993
# Report

The western regional coordinator has chosen The Math Team as a focus for the evaluation study. This statewide group is coordinated and co-facilitated from the western regional support center. The math team began as an interest group in May, 1992 and was awarded federal grant money to engage in a year-long training intensive training from for 20 practitioners and staff beginning in October/November, 1992. As part of the team, practitioners have been involved in a variety of individual, working group and team activities over the course of the year and create individual projects and team products.

This study was conducted in the eighth month of the project, while participants were engaged in teaching/research projects in their classrooms. The goal of the study is to understand how the members perceive the working of the Math Team while they are still intensively engaged in activities. How does the Math Team work as a staff development activity? How is affecting their attitudes, knowledge, and actions? Questions were designed to gather information on practitioners' perceptions of the two major phases, the structure of the project, and the impact on the Math Team on their work.

Three focus groups, including 17 of the 18 practitioner members, met during a regularly scheduled team meeting. Members split into three of the four of their regular Math Team working groups, with members of the fourth group divided between two others. Additional information was gathered in three individual interviews and one telephone interview with the facilitators and product coordinators (Information from these interviews is not included in this draft.)

## I.The Math Team -- Overview

Of the Math Teams' 22 members, 18 are practitioners participating in all phases of the project. Three SABES/DOE staff members work with other team members planning and coordinating activities, facilitating meetings, providing technical assistance, and administering the grant. A doctoral student at the University of Massachusetts has been observing, participating and working with SABES Central Resource Center on a separate mathematics project.

The practitioner group is composed primarily of experienced adult educators quite familiar with SABES activities. Only two members of the group have less than two years of adult education experience; others range from five to twenty years in the field (with about half of the group in the five to six year range). The group is nearly evenly split between those who have full time jobs in adult education and those who are part-time. All Math Team members have at least a BA; half the participants have attained an MA degree. Nearly all of the group identify themselves as teaching in the ABE/PreGED/GED sequence, with several engaged in workplace education projects. One-third of the Math Team members identify themselves as coordinators or directors. Only a few of the team are mathematics specialists; most teach other subjects and, as they discuss in the focus group, a substantial proportion of the group did not consider themselves to be strong math teachers or strongly mathematically inclined themselves.

Only three members of the group have participated in fewer than five different kinds of SABES training/development activities (with workshops/minicourses listed as one type). Most have attended Network conferences; one-third of the members have made presentations. Six have received mini-grants. Several have written articles or edited students publications or have presented SABES workshops.

Members joined the Math Team at different points in its history and with different interests and expectations. A number had come together in May, 1992, as a statewide group, facilitated by the Department of Education Supervisor of Development, to talk about teaching mathematics and improving their teaching. Several of these members had been part of an earlier group that met to consider GED math issues. Once the group had chosen to work on adaptation of the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics to adult learning environments, a successful grant was written by several SABES staff to fund a year-long teacher development project. Several teachers joined the Math Team during the summer and early fall, as the project got underway and incorporated teachers under another state project, PALMS.

Groups/Activities: Members have met monthly in Central Massachusetts for training and business sessions and have broken out four groups meeting regularly in different parts of the state to work on different applications of the standards (ABE, GED, ESL, and Workplace education) and to support its members in their projects. In addition, a weekend training retreat was held in January.

Tasks: The project has several major tasks in which members are involved: to review NCTM standards and adapt them to four adult learning environments, to implement these standards in their programs using a field-based research approach, to produce a publication that includes the research process, findings, and sample curricula and teaching materials. At the time of this study, the four groups had prepared draft standards, which were compiled and edited by two team members hired as product coordinators. The first draft of the standards was released to the team in April. Individual members had designed and implemented their projects in their agencies. In May, members had reached different points in their projects, from implementation through analysis and writing. They planned to complete projects and write about them over the summer.

Roles: The Team is facilitated and staffed by and the SABES Western Regional

BEST COPY AVAILABLE

coordinator and the DOE Supervisor of Development, who also acts as on-site resource to some of the members through the PALMS project. (?) Two team members are also project coordinators, compiling the standards and other publications. A SABES staff member from the Greater Boston Region has operated as a resource person and trainer. Product coordinators and Math Team members are paid (or their agencies are paid) for their participation in the project.

## II. Impact of the Math Team on Practitioners and Their Teaching

The Math Team has been geared to the development of its members as mathematics teachers through review and adaptation of the national math standards to adult education environment, and design and implementation of research projects in their classrooms or agencies. For the past several months, Math Team members have been engaged in carrying out their projects, experimenting with approaches to mathematics in their classrooms and systematically gathering information on learners' responses. They will be drawing conclusions about their work later in the summer and are now in the midst of experiencing what they perceive as the successes and failures of their experiments with individual activities in their classrooms. In the focus groups, they discussed the immediate affects of these changes in their teaching on individuals, on their classrooms, on themselves and sometimes on colleagues in their agencies and on others. In the following vignette and in the sections belong, members discuss the ways in which participation on the Math Team has affected their attitudes, their teaching and their sense of themselves as professionals.

### Vignette – A Math Class

> *It's funny, because I invited the director to come and I kept saying to him, "Come sometime and see our math group. This one night I thought it would be a good activity. I said, "Come and see." Well, it was from Get It Together. It took me along time to understand why the title of that book was called what it is....I was using one of those and it was all about how she drives here and she drives here, she fills her tank and how much is it going to cost to take a trip and so the people were doing it and he came into the room when there was a lot of confusion, I think. There were four different groups working on it. The were all talking and everything....What he picked up knowing nothing about what was going on, was how energized they all were to try to get the answer and to try to work on it together. He just kept saying, "This is fantastic! Everybody is involved." It was sort of like saying back to me – the teacher who's so concerned about control – that he could pick up on the excitement of it. It wasn't the perfect evening. For example, we ran out of time and they had to leave. None of the group had solved it before the evening was over, and he wanted to know about that. I said," Well, when we come back next time, we'll go right back into it." And it wrapped up nicely the next class.*

### Vignette – Looking at Learning and Teaching

> *Some say, too, "How is this going into other areas of our lives, not just in our math class. Last Saturday I was in charge of making the totem poles for the Brownies. We were in this camp thing and there were in groups of nine and there were five groups. The kids who came whose leaders said, "three of you sit there" the kids who were told where to sit, what to draw, what colors to use, came up with really blase kind of totem poles. But the kids whose leaders let them go sit, let them color and od, came up with fabulous things. And I find that in my teaching that that's a good idea, to pull back and allow them to use manipulatives and not bother them. That thing [the training session] martha was trying to show us about what to say one after the other, and I had forgotten about that because I was kind of frustrated, but what I did like about that meeting was Barbara telling us about her use of manipulatives and I did that with my students and they loved it and they understood subtracting fractions. When they use the manipulatives, to be able to pull back and allow them to explore.*

### Vignette - Individual/ Professional Growth

> *...at the beginning of all of this I was not interested in developing my own personal math skills and what I was doing in the classroom. [it was] enough to attend. Especially when it gets me home late every time I attend one of these things.....It's been sort of a religious experience for me to be on this math team. Because I was not a math type. I remember making a comment at one of the earlier work group meetings, like, "I don't teach geometry. Like what do people need that for?" That's how bad I was. So it's been really tremendous for me to be a part of this. It hasn't been without blood, sweat and tears in a lot of ways, but it's been really terrific for me.... "But why do I do it," you could say. Even though it hasn't been easy, it's like something I can't help now. My husband gets a kick out of it. I never even turned on a computer until I was on this math team. My kids run the computer, my husband has a computer company and I never turned the computer on. That's been one of the things. I've changed so much as part of being on this team. I know I've only just started.*

**Reaching students.** At this point in the project, many noted that participation in the Math Team has affected not only their own understanding of mathematics but their ability to reach the students in their classes, and sometimes outside of classes.

> *I feel its been a tremendous personal/professional growth in this whole experience.e I feel like skills and abilities that were sort of latent are really being encouraged and developed. I ended up because of personal history or whatever, not taking math beyond high school...I knew i liked math and I always think in numbers. This has made it okay and it's shown me ways that I can bring it back and bring it home for my students better. That's always the big thing for me as I want to be able to apply it. That's probably the biggest reason and I feel like it just keeps expanding.*

BEST COPY AVAILABLE

> *I've been teaching math for a long, long time and find that probably 99 % of my students have difficulty with math. So I'm constantly struggling for new and different ways to present the same old material to them to make it more understandable for them. I found this extremely interesting and I still haven't found the road to make it easier for them but at least it's different roads that I can try. I think eventually it will be that type of situation for me.*
>
> *{describing the journal writing project} We'll do cut outs for triangles, then they'll write me that they've tried this at home with their kids. (see also page XX?)*
>
> *I've had carry overs that I didn't think students would go home with the problem, actually work on it and come back with a solution. This is something that didn't use to happen very often.*
>
> *I've had students mention that they've worked with their children at home on it. They've got their husbands and wives involved in it. "We worked at it together" and this whole kind of thing that I don't think a work sheet would have the same effect.*
>
> *In my work place I've had people -- I give them a Jose and Arthur problem just to boggle their minds. And he said, "My wife and I had the biggest fight over Jose and Arthur, cam back and we still didn't figure it out. You better tell me the answer!" I said, "Well, give it another day, we'll see." Then two people in my morning class in my ABE class they were interested in purchasing the family math book and working with their kids on it and stuff like that. Some of them have kids in school who are starting to work with more manipulatives...so it really does carry over.*
>
> *With the pattern blocks I had a student and I didn't know this for a while, she went home and she made her own pattern blocks. She traced them in class. She came back and showed me what she had made. She's been playing with them at home. they wanted to know where to buy them.*
>
> *The first time I did Quiz and { }, she wanted to get them for her kids. She said," I can see my kids could learn." That was amazing to me given her traditional learning and my experience teaching. A lot of connections.*

**Sharing Ideas with Other Team Members.** The Math Team has been a source of energy and motivation for members, an environment in which to share ideas about mathematics and teaching with others from around the state.

> *The thing I've loved about the group is also hearing people from all over the state what they're doing. Sometimes you get very isolated and the whole world seems to be around the walls of your own center and that's where everything is happening. It's just wonderful to have this kind of sharing and dialogue going on. I feel like we're being like a community of educators here. That's been very exciting, done not for a*

BEST COPY AVAILABLE

> *long length of hours, yet you feel like this is where you discuss educational issues. I just feel like I keep wanting to bring this spirit back to where I'm working because I just feel like this is what we've lost sight of and what we got back to. Remembering why we're in this business in the first place, to education not to scramble for this funding or that funding or this classroom or these hours or new equipment, this or that. But getting back to the kernel of it. This has been a wonderful experience.*
>
> *I have no time for any of this, yet it's been the most exhilarating part of my year in many ways. Just to get you going again {in a later conversation"} it breaks you out of the mold. I love it!*

**Teaching Other Subjects.** Involvement with the Math Team has had an impact not only on their teaching of mathematics but on the teaching of other subjects as well.

> *I find that the focusing on the standards was very appropriate and productive I've been applying them to areas that may not be math at all. I just think the whole concept of the standards goes across all disciplines. Talking about it at work, we're revising our adult diploma program. I'm changing little bits of the teaching I've been doing for 20 years, shifting a little, trying some things, some successful, some failures {speaking again later}.... The thing I've been noticing from day one, we're talking about an approach to education, to problem solving. We just happen to be in a content area of math. That is the last of what we seem to be accomplishing here. That's math content, we're not focusing on specific math content, instead we're focusing on an educational approach. And not every attempt I've tried — I've had some things that looked pretty bad.*
>
> *I agree though that it's very time intensive and it's energy intensive and I forget sometimes that I'm teaching four other subjects, not just math. And I want to be able to do for those four subjects what I do in Math because that's my job. But it can be expanded to the other subjects. That happens more and more, so I think it's that would be encouraging me to keep coming as much as I want to keep learning more about math.*
>
> *I had just came from my teacher certification where it was like this is the Bible that the whole class is run from, my math methods class was here you go, class over. "Just know this and you'll be fine." I guess what I get from it is less about math and less about this method of teaching math, but more about what it means to be a teacher and what teaching is and also, like Tricia, how to use this in my science class, how to spread this type of thinking into all the subjects.*
>
> *It's finally made sense to me what whole language reading and writing is, what that means because I can say it's doing in English what I do in my math language, the same thing. Then I start off with "Where are you?" not "These are the rules , do it." It's "Where are you? What questions are interesting to you? What do you want to*

*about? Where do you see the problems? What sounds funny to you? What do [illegible] is right about the way you're approaching math problems? Where is the [illegible]? Where do you feel stuck?" Exactly those questions in math work in every [illegible]. It's all about thinking. That's it right there.*

*[illegible] the things is strategies. I've learned. You almost have your basic, familiar [illegible] that we use all the time. Through being with the math team, I've learned [illegible] strategies, like draw pictures, cut pieces of paper. Ratio and proportion .... [illegible] is a ratio in proportion. So it's really opened my eyes for new strategies [illegible] is applicable -- that being open to see new ways, new approaches to things [illegible] to everything you do.*

*[illegible] an enormous amount to learn about ABE learners. That's not a group that I [illegible] familiar with, though I'm familiar with them from sort of a different aspect and [illegible] not much different from other people that I've taught but I still have learned [illegible] enormous amount but not enough about...I'm beginning to learn a lot about [illegible] other subjects, but I never teach history, social studies.... I'm learning more [illegible] a buddy...we're there together.*

*It's changed the way I teach social studies....I have my class on the map of the United States and putting their hands on a state and telling me places that they've been and what's worth doing there. We're all hanging around the map. And Karen's idea. "You're the Supreme Court and You're the President...and that kind of stuff.*

*I think the standards are kind of bigger than math, really. The philosophy that's much larger than math because you find out [about] all the different areas.*

**Sharing with Other Colleagues.** While the focus of the Math Team this year has been on individual learning math development rather than dissemination of ideas, Math Team participants noted that they are sharing information within their agencies, with other teachers and administrators, and with others outside their agencies. Both the individual activities and the connection of these to the national standards have been important.

> *The fact that we're doing the math standards that were national math standards and we're adapting those national standards has given our entire task a legitimacy that it might not have had otherwise. I don't mean this internally, but external legitimacy. When I talk to colleagues at work, at conferences, different people in the publishing community, the fact that we're doing this has legitimacy. We're taking an already respected body of work and we're adapting it to our special situation rather than starting from scratch I think it was very wise. We're doing a lot of clout. I feel real good about that.*

> *It does carry out with peers because one of my coworkers just happened to take her masters program last summer and takes some pretty exciting courses in terms of math.*

*Although she's not ont he math team, she and I are constantly swapping ideas and it's with excitement. There's another teacher who's just a sponge and sh's always there, so that is nice.*

**Accomplishments: Individual Perspectives.** Participants shared a strong sense of excitement about both their own and the teams' accomplishments to date. What is impressive is the variety of different levels on which Math Team members were motivated and areas in which they felt a sense of accomplishment. While the report will examine some of these areas in detail, the following responses illustrate the variety of areas in which team members felt that they or the team had made important strides.

*I don't find my way easily and I was told to go so some place in Cambridge. I drove around for two hours and I never got there....But I have mastered finding my way, so that's quite an accomplishment. That's a critical accomplishment for me. I really couldn't find my way anywhere.*

*[I'm] feeling more comfortable with math....I was uncomfortable with not knowing what this was all about. Just growing up not thinking and never being encouraged either.*

*I think a major accomplishment was getting a group of teachers throughout the state who had never met each other and could cooperate, get along so well and do such a great job. yes, fantastic work {another member adds} and arrange meetings!*

*I think we have a heightened awareness of what standards are and how they can be implemented into the adult basic educations, for us, and we can spread the word to other people.*

*And the application of our projects in our classroom and seeing the tremendous results that they are having. I'm very pleased with it.*

*I feel just by working in my center, someone will say, "My child is having trouble with this, what do you think?" or they have a student in their class who may be a question. "What do you think?" What can we do, perhaps as a resource person, just our enthusiasm perhaps taking that to our [agencies], with our peers.*

*I think a major accomplishment, maybe the money had to do [with it] is that we didn't have much attrition.*

*I realized that when I worked on the Make a Tape table and everybody who committed to sending in an idea or to being there showed up and did it and got it. {another member} Great cooperation.*

BEST COPY AVAILABLE

> *Sometimes I feel like kind of an expert in math. I never visualized myself as that before.*
>
> *I never thought of myself as a math teacher. Me on the Math Team? I teach some math, but I've been an ESL teacher all these years.... I can do math well. I've never had a problem with math, but I wasn't a math teacher and now I see myself as a math teacher. I can do it and I'm not concerned about it or worried about it. I have fun with it and if I don't understand something, I know there are other people who can help me find the answer. I see myself differently. I've achieved a lot of personal fulfillment from this. It's been a learning experience for me, not just for my students.*

## III. Process: What has worked?

As is apparent in examples throughout this report members of the team described their experiences as a process of learning and discovery for themselves as well as for their students. In talking both about the team and about their current research projects, they described themselves growing in understanding as they participated in the tasks.

> *My sense was that I didn't know what I was doing until I started doing it. One thing kind of snowballed and went to another and working on it. I agree with you, I felt that way that we needed more time to think about it, but I don't know if all the thinking would have [made] any difference. Because until you do it-- you just kind of dive in and go from there. I agree it would have been nice to be a little clearer before starting.*

### Staying on the team -- Motivation.

While the time commitment has been substantial, the distances to travel long for many of the group, only one person left the team in the early stages, unable to make the time commitment necessary. The compensation for the project, the individual commitment to the work groups, the excitement and challenges generated, and the feeling of contributing to an important project were among the reasons cited for staying with the team.

**Limiting the Group Size/Membership.** Limiting the size of the group and making a commitment for important decisions to the success of the team.

> *I think an important part of the fact that we stayed with it was there was a point of commitment at the end of October, beginning of November where we said whether we would or would not and I know someone did drop out at that point. Maybe that's why the rest of us stayed. I think you need that to make some sort of -- if you're really going to get anything done, the people who are part of it should make a commitment to each other. That's my opinion.*
>
> *One person dropped at the very beginning. It wasn't his choice, he wanted to*

*participate but couldn't.*

(Four of the seven members of one group recall the longer history of the team in this discussion.)

*When we first started in May, {before the grant funded project} we did a lot of struggling trying to decide what we were going to do and how we were going to do it and we were just kind of meeting on our own for free for fun, waiting for funding. As more and more people started coming.... I kept thinking, "Well, today we have twenty, next month we'll have forty people and it's already frustrating trying to get through things.... it was wonderful that we did break down into groups because we accomplished a lot in groups and the big team. We really get a chance to share and that's a good time. If we constantly met like that, it wouldn't have been effective. I think we kind of struggled with that early on because we kept changing players. Some of the same people that were there in May when we were planning this, hoping for funding, All of a sudden a completely different range of players and I felt real awkward about that at first.*

*{another member adds} Mary Jane obviously addressed that issue head on. I approached her with a couple of people in the center. She said, "Well, it's too late, We've closed it." That was a good move on her part... {another member adds} Do you know how many discussions we had on that before she finally made that decision? We went round and round. {first speaker responds} But it was a good one. It was the right decision, even though there were people left out....It's a good lesson, I think we've all learned that it's good to have closure.*

*{the first member rejoins} The group meetings dividing the larger groups into smaller groups narrowed the focus. We didn't have to each consider the whole spectrum of these standards, but just a component, which didn't seem so overwhelming. Then we'd get input from the others, so we could see what they were doing, but narrowing our own focus was very helpful. {another member adds}{ Even though there's a lot of overlap. {another adds} There would be. We found that out.*

**Compensation.** Being paid for participation in Math Team Activities over the year provided impetus to continue, even with completing commitments, and gave some leverage at organizations. Payment, particularly at the beginning of the grant-funded project before the sense of team camaraderie had grown, combined with other factors to hold people even though the team has been "energy intensive and time intensive."

*I wanted to come but couldn't get out of the building. Once my center was getting a few dollars from me coming, then I had no problem getting release time, especially outside of my work hours.*

*And the support that you get here. I feel like whenever we have a work group*

> *meeting, it feels like I've just gotten a pat on the back on my way out. "Gee I do have something worthwhile to say. I think that it's those kinds of things as much -- but I wouldn't have put my foot in the door if it weren't for the money. I almost dropped out when [the other teacher] did, except that I really needed the money. That was a big question and the money made the difference then.*
>
> *It was not at all what I expected. I'll be even more honest and say that if it was not direct compensation for attending, I probably would not have come to all but a handful of these because I am not, at least I should say, at the beginning of all of this, I was not interested in developing my own personal math skills, and what I was doing in the classroom enough to attend. I'm a real family person so, if you're not going to pay me to be away from my kids, damn it, I'm not going to be away from my kids. That almost the way I felt about it.... Now I'm wondering if next year they still have the Math Team and there's no compensation, will I go? Earlier back in November, I had said 'No, I will not go." Now I don't know what I'll do....*
>
> *I confess that the money keeps me going. I really feel that the best, a real critical part of keeping us true to our commitments, that people have to be compensated for the time because otherwise, it's not just that we all would be laying back sitting by the pool drinking mint juleps. We might have to find other ways to find that compensation. More a second job.... Everywhere I've ever gone, every group of teachers I've ever interviewed...when they have been paid even though not great rates...to go and be a professional, whether its a t a workshop or whether it's at a conference, have said, "I've never been treated like a professional before within my own institution....This has done that, has made everybody sit up and say, "I may not know abut math, but do know about teaching and I'm being treated as a professional on that basis.*
>
> *{Another member continues} Women and teachers [belong' to subgroups or whatever of humanity that I feel are asked to volunteer a lot and just do stuff for nothing out of the goodness of our hearts. and I think it' real validating professionally and personally to get the [money].*

**Professional Challenges.** The Math Team has provided the opportunity and encouragement for these practitioners to work on innovative classroom projects, try new ideas and challenge themselves in their own learning and teaching. For these (primarily) experienced practitioners, the sense of making changes and being able to reach students was important. A number described a spirit of excitement and enthusiasm that the team has generated.

> *I think the fact that we're trying to make a change, too.... I think we need to reform education....I feel like one of the things we're trying to do is start to be a change agent for world adult education and especially in math. That's needed.{a second speaker adds}And if the adults change, then the children will change because many of*

> *them are parents so they can bring the changes into the home, too.{a third adds}If they change their attitude about math, because we've changed our attitude about the way we teach math, that will definitely impact future generations.*

> *It's like we're treading on thin ice, darn it, new territory, being a change agency. We don't know where we're going but you just -- I always call it "failing forward"....We're not sure what we'll have when we get there, like this big project, what's it going to look like, who knows! We're making changes, at least we're trying stuff that's important....it's a challenge! That's what keeps us going.*

> *..a key word was spirit. Even though we're all frustrated, all over-worked and underpaid, there's a lot of spirit. I know our night time group, we're getting together at 6:30 at night after working all day. I think there's still a lot of spirit, a lot of energy, whether we're frustrated or not, trying to work through our projects, but we're still just a good positive sense there.*

> *I think we stay because we're not really sure we know what we're doing so we keep going to the next meeting to make sure we know what we're doing.*

**Responsibility to the group.** Members have come to feel responsible to the group of people they admire and respect, particularly in the work groups.

> *But the key thing here is, we've got to go back to our center, do something, then we've got to tell everybody here what we do. So if you didn't do anything it's really hard to make it up....There's also respect for each other that helps kind of motivate it along. You don't want to look at all these people you feel good about and say, "I didn't have time." So you do something and you feel real good about it.*

> *{Talking about what has encouraged her to keep coming} ...and I really like the people, the "club". It's a good group of people and it's taught me a lot just about professional human being and lots of concern and encouragement maybe when you're questioning your commitment.*

## Crucial Elements of the Math Team

**"Talking Math."** The Math Team provided the almost unique opportunity to focus on math and math learning for an extended period of time with others. Having the opportunity to "talk math" is a recurring theme throughout the report. For those who consider themselves to be experienced at mathematics and those who were not "math people", the team was a primary source of support in the math area. A discussion in one of the groups is illustrative.

> *The work of the math team has become more important [to] us as math learners, though we do it ourselves. Some people I've been told have nobody to guide them, to model for them, to show them, to help them think about how experiencing this kind of*

BEST COPY AVAILABLE

> *mathematical learning is very important for people who are going to teach it... They're very isolated for instance, or they don't know what to ask for -- only to get at things, either have something come to them or to have them at these larger meetings....At our larger meetings, that's one of the things I did expect...was that we would be exploring more mathematical ideas with the larger group....*
>
> *On the other hand, it seems to me that's the point of the big meetings is to get the business done. Because, like you said, we don't want to have to meet twice as often.*
>
> *But you are a math person. For someone who isn't a math person, they can't do the math on their own. They can't model. They don't know what it is they are trying to do.*
>
> *That's was my reason for joining.*
>
> *I disagree. I think that just because I'm a math person means that I don't't' see what I do because it is so reflexive for me to simplify the problem, throwing in numbers that are easier.*
>
> *So, then, to have a meeting would be useful to you if we did more math.*
>
> *{End of Discussion}* ****
>
> *I don't think we talked about math as much before. We might say, "Do you like this book?" But since we've been on the math team together...We're talking more.*

**Having Fun.** The excitement generated by the work together on the team is apparent in the examples throughout this report. Several participants were explicit in their description of the Math Team as fun. This excitement has carried from the team to the classrooms and back to the team.

> *We have fun together. It's not a task anymore, but, "Let's go out and have dinner together." That to me takes on a different sense.*
>
> *If I have to rationalize it, if I have to take a step back and say , "Why does m director let me spend this many hours doing it, because it means doing my job better. But in terms of how I really feel, it's fun.*
>
> *We have a lot of fun, which is an important element. I try to have fun in my math class when they're so depressed because they can't do something. We have to find something funny about it because there has to be some kind of joy in the subject even though they think there isn't.*
>
> *We had a staff meeting a couple of weeks ago. [Another math team member] and I*

*were experiment more with group work and lot of the part-timers individualize. One of those same teachers, it was a public school teacher by day, teaches at night, she came by my room. She was joking but said, " ...that can't be a math class, they're having too much fun! Too much noise and laughter coming from your room. It sounds like an ESL class!" I've had that comment but not with the same connotation that, "Wow, this is math and they're having fun!"*

*I like the stuff anyway but I never expected to have this good a time.*

*I knew...that I would have a good time. It's probably surpassed my expectations.*

**Teamwork, leadership and support.** Members seem to share a strong sense of participation, of team work and of support from the Math Team leadership.

*I feel this is the first group on a professional level that I've been part of that somebody's not always trying for center stage. Everybody seems to want to help. I haven't found anybody, unless I missed somebody trying to be on center stage, nobody's trying for that at all. We;re all trying to help one another accomplish the goals of the team. Very impressive.*

*I just find in a world where we're always talking about funding and lousy bosses and things like that, it's great to have a group that al we talk about is being educators and how to be effective educators. This is the most educational professional group I've been in.*

*I think the fact that the project grew out of teachers' setting their own priorities. the DOE/SABEs is really responsive. [We have] a project that meant what we wanted and not some policy maker.*

*If anything, we hear all these accolades about Mary Jane and she's always trying to deflect that and saying, "no, no, it's not me, its' everything." At this point, there's a lot of truth to that. It is [everything], but she was certainly the catalyst and she deserves 100 % of the credit for this thing coming into being. It's also true that right now it's been created as such a positive energy, its taken on a life of its own, that even if she did something else and left the scene, it could even continue.It's no longer dependent on one person, but certainly would never have happened without that person. To me, that's an incredible accomplishment on her part.*

*She's an incredibly accomplished person. She's on focus even if the rest of us all aren't. She certainly knows where she's going.*

*Mary Jane, pure support. she has a reference to anything*

*You can call her at any time.*

BEST COPY AVAILABLE

> *We received a great amount of support from Mary Jane personally [in PALMS]. Unfortunately, I felt disconnect from the rest [of PALMS} totally.*

## III. The structure of the Math Team: How have members responded?

Some members of the group have been a part of the team since the first meetings in May, 1992, others joined later, particularly after the grant funding came through and when another math project [PALMS] joined with the math team. Several had been part of the original group that met to define the focus on the standards and the form of the grant. They found that limiting the size of the group has proved to be good idea, as noted above. Forming small groups in addition to meeting in a large group allowed participants to focus on tasks. Choosing one area in which to consider standards gave further structure to the initial stage of the project.

### The Work Groups

The work groups were described as sources of support, encouragement and mutual learning. At this point in the projects, Math Team members have found that the working groups, originally formed to adapt the standards, have functioned well for them as they have taken on their research projects. Members talked about their respect and enjoyment of each other in the team. Many talk with each other between meetings. For some, being on the Math Team relieves the isolation of individual teaching. One group was making plans to go out to dinner together as the beginning of the focus group.

> *I love those sub groups. When we worked on the standards, we were real strong, very opinionated, but nobody was into digging in their heels and slugging it out on every little thing. There was a lot of listening and no matter how strongly people felt about things, ears were also opened....I like the stuff [math] anyway, but I never expected to have good a time, especially in the subgroup. We hit it off immediately. Some of these folks probably know each other. I didn't know anybody in this group before I got involved in it and it's been a marvelous good time.*
>
> *I think sharing was one of the most important pieces. You get refreshed. In our subteam, just the fact that we share with each other and "I'm having the same problem." "It really does sound good...it's not a dumb idea that you had" kind of thing. The support and sharing that we give to each other, whether the big or small team, I think that to me is critical and the feedback*
>
> *{Discussing memorable activities} When we talked about projects and we each said a little schpiel about our projects and everybody seemed to help with it, that was really good.*
>
> *It was interesting to hear each of the participants' comments because they would be talking from their point of view. They were all different, so we had a lot of fun*

*beside --a lot of exchange of humor....We had a lot of laughs even though we were really into serious business.*

*I like the work groups very much because that's what I had originally anticipated to make sure the whole math team was going to be was -- teachers joining me and my development as a math teacher/learner and that's what I find, especially for me, I feed off of these three constantly.*

*The more personal experiences that grow me as a teach, as a math learner, have come from working with [these] three, going over what they say to me...{ another member adds}...you don't have to wait a month to have the discussion, because we are all in the genera area....{first speaker] Just hearing from somebody else whom I respect. That's great. There's time for us to talk like that.*

*It's definitely the personal that happens in the smaller group, is that [I] get taken care of.*

*They're warm and fuzzy {another member adds} We're among friends... {another} I have to add, I still have to travel.*

*The real pleasure for me is in watching us as a small group get to know each other from the first fight we had at the first meeting [another teacher and I] ....Watching us find out were there were bumps and how to get through them and after that just watching us get to know each other's thinking so that our dialogue became even easier. You never have self-conscious dialogue -- you're right, I don't remember what we talked about. We get what we need. We go away. We don't need to credit to anybody, or chronicle it or do anything, we just think about it, remember who said it, that's find. But we just sort of use each other, quite pleasantly.*

*I do think that the small group thing when we actually got to the teacher research thing, they were much more helpful than these large team things. These large team things to me felt more like business for Mary Jane and all of her arms into the work, the country and the Bureau and all that sort of stuff. Directly for me as a teacher/researcher, I think that the time , the emphasis was correctly placed on [the small groups]*

*I'm the only one who does math at the center. Sometimes I feel like I'm this island and basically I can do whatever I want. But it's nice to have a group to say, "What do you think? Am I on track here or not?" Or to bounce ideas off of and collect ideas of what might be something nice to try. I found that invaluable.*

*We did a lot of traveling [two teachers] and [we spent a lot of time talking, which was good. It was great having some positive feedback and somebody who understood what I was talking about. I am the only pre ASE teacher at my center.... It was good.*

BEST COPY AVAILABLE

*That's true for me at my center, too [that she felt isolated]....I have the same feeling it was good jut to talk to other people who are involved in doing some of the other things and also to get the support when something that you thought was going to go great went lousy. You think they're going to come up with these stupendous outstanding earth shattering, philosophical lights of dawn and you thin it's going to be this big thing and everybody looks at you like, "What the hell is she talking about?" It's good to hear things like that so you know.*

*Ruth was usually our note taker -- did an incredible job of just bringing into focus what we spent two hours discussing and I could look at her notes and it all made sense and that's what we discussed. It only took ten minutes to read it.*

*What was important to me is Martha Merson was the note taker in our group and I was amazed at her ability. That is the most memorable thing. She would give back the whole two hours and had it all. Who said what, and I wouldn't even remember who said what. She's incredible, she's an exceptionally good not taker.*

There were very few comments about problems encountered in the small groups. In one group, two people were uncomfortable tape recording all the small group sessions.

> *I hate the tape recorder. We take notes especially when we were doing the standards, we wold share note taking and each one of us had a turn where we wrote up the notes and we had to send them out to folks or we have them to Ruth. To me that was fine, but you have that tape recorder there....this is my own opinion, I felt like somebody was checking up to make sure we had a meeting. That bothered me because there was no way we could really look back over all that and get anything out out it, when you talk for two hours.*
>
> *{another member of that group adds} I just thought it was ridiculous because what was happening was all these groups are meeting, generating dozens of hours of tapes. Who in the world is ever going to listen to this stuff. We certainly never listened to it again and neither do we want to. {the note taking by a group member was highly satisfactory, as noted above.}*
>
> *{a third person, from another working group.} I didn't find that. I forget that it's even there, so the tape recorder, even though I agree with what your comments are, I understand what you're saying, it would never bother me.*

## Large Group - Team meetings

The large group meetings are the opportunity for people to come together as a larger group, as a "mathematics community," to share with each other and to learn about mathematics together. In the focus groups, participants discussed those opportunities many

BEST COPY AVAILABLE

frustrations involved in getting together and conducting business over the year.

> *In the [work] group, we were only with four or five with whom we were working in particular on the part of the project. When the whole team gets together, it's just so nice to see everybody else and there's always something to share in a different way when everybody's together, too.*
>
> *I would have to say that some of the best activities we did as a large team were when we did the cake problem. That was a lot of fun. That whole day which we did primarily math. {another member adds} And watching other people, how they did their math.*
>
> *I like to drive to and from, when we come together. Driving alone I would hate. I would get lost. {another member} A chance to talk math. {another} We talk real hard. {another} Once we went with Bill and that was fun. {another} We never stop talking. We teach in the same building.*

As several participants commented in the discussions, the large and small groups filled very different functions for the team. Most of the common business was conducted in the large groups along with training sessions. As noted by one member, each group had its sources of validation.

> *I have to admit that the validation comes from a large team, what has stressed me into. My involvement even in the big team has forced me into doing things like managing the computer, actually start to get out there and explore and communicate to other teachers through it.... So I can say it's just this. The more persona experiences that grow me as a teacher, as a math learner, have come from working with [the work group].*
>
> *...[the small group] is not sort of ," Oh, I remember we sent to some institute, the cake problem, or I remember we just did research information into recent protocol practices. The big team meetings, I can almost remember what the agendas were, but i our small groups, it's more just an ongoing dialogue and you still step in and it's right there and it's going.*
>
> *The mixture of small and large group I think is the big difference between [the Math Team] and {a sharing group} that makes this group better...The combination of the informality of the small group and the bit moe formal, structured set up of the large group is a good mix.*

The size of the group, and the timing of meetings caused frustration for members of the group. "Getting twenty people together on Friday afternoon is hard!" Gathering a statewide group meant that members were late to meetings.

> *Friday afternoon is a terrible time, but I don't know when else we can get away. A lot of us with family obligations are thinking about getting home and Friday afternoon is not the ideal time....there is not a good time.*

> *Time factor, we started 30 minutes late today. {another member} "We always do. It's frustrating."*

> *I think if the math team is up and running that some of these big meeting should take place in Western Mass.*

The meetings had full agendas, allowing for little time for discussions among participants.

> *It's real hard. You're caught between a rock and a hard place. We've got a lot to get done.*

> *There's always an agenda, always a plan, like for this hour Martha is going to teach us this and we're going to do this or this. We're going to have a half hour that they're going t talk about how the standards are going and everybody is grabbing every minute....that's extremely frustrating.*

> *They're trying to do too much here. They spend about 45 minutes on announcements. I can't hear the announcements anyway....announcements should be just on a handout and don't try to announce them.{comments by two other members -- "I hear them, but it's so overwhelming, because there's so many diverse things." "We have a lot going on, a lot of good stuff, but it gets to be too much."*

> *Sometimes I think they get out of focus of what we're doing. I think we can get of on tangents that aren't really applicable to everybody and that's the nice thing about the [work] group. You do seem to stay more focused.*

> *Someone else's problem is not something that you feel is helpful to you, or someone else's focus maybe too, like you said, there's such a large group.*

> *[Two of us] were talking about another room. The noise level...to me to be in there for four hours, I'm on edge because of the noise.*

Because the training involved trying activities, learning and reacting to them, the limited time in the meetings was the source of some frustration in learning. Several members noted that there was less emphasis on math in the larger group that they would like.

> *Some of the training that Martha has done is, like I feel like I'm not getting out of it what they hoped they would give us. It's like, either the time is too short, and I'm thinking about our last session.... either because so many of us are trying to get*

*together and we're running late...so we don't get started until late. Today is a perfect example. It seems with just a large group, I feel like what their plans are for us to get out of it is well meaning, but is probably typical of what happens in a classroom. You think you're going to teach all this stuff and the students go away with half of what was expected. I don't know how that can be changed. Trying to get twenty people together on a Friday afternoon is really hard... I remember last time I was really frustrated. I felt like time ran out and we were following a process and we got to the point that, it's good to learn the processes, you say the wrong thing at the wrong time You get to the point, "Do I open my mouth or not." It's well intended and well meaning, but because we get together so seldom, it frustrates me.*

*{Recommendation} To make room in the agenda for us to be community of mathematics and to be part of the mathematic community, to get the feeling that we get in our small groups in our big group. I wish that I knew that I was coming here to look forward to on the board with an interesting math problem, and we don't sit down to doing it for 20 minutes, then we get cut off.... Conduct a little business, have a break that's long enough for us to talk to each other. There are people here that I only wave to as we go by....that would be my recommendation and then food {another member adds} pizza and beer! {first speaker} Again, it's treating ourselves as professionals. You're going to stay through 5:30 and you're not going to get home until :00 and you eat high sugar food...I've been working all day. I've rushed to get here. I've been here. I worked frantically and I've eaten all this sort of [high sugar] food. You get home and you crash. And then you think, "Do I want to do that again? Where's the incentive besides the money for the big meetings?" And yet I see the reasons.*

Several participants connected the business/time/agenda problems to the necessities of the grant funding for the project and suggested a future return to more exploration.

*I think that an opportunity cam along -- this big grant -- and it was a rare opportunity. It altered in a way our activities. I think that we were starting to do math sorts of things and the grant came along...we got immersed in that and have been for moths now.....I have a feeling that it would be a future direction for us to go and refocus back on math technique and exploration.*

*I know when we were looking at the whole grant scheme, I keep thinking I was supposed to finish some of this research, we were supposed to have more time together, but we had money so we could do something. So you jump on it when it happens.*

*I would have liked more workshops with manipulatives and working together like that, even prior to starting our projects. I think we were so rushed and we had to do so much in such a limited amount of time, I think that's where the pressure came from and that's what bothered most of us. If we had had more time to see this evolve and*

> *work a little ;more slowly and have more workshops and see exactly what it was we were going to do and define our projects better, then do into it in the fall with a clearer picture of it...I think that would have been better for all us. But the deadlines. The PALMS and the standards together has been a lot.*

### Retreat/Workshop

In thinking back over their experiences on the Math Team, several members recalled that the retreat was a good opportunity for an intense exposure to math and for getting to know each other as a group.

> *I enjoyed our overnight little workshop, even though a lot of it could have been done a little more efficiently, but a lot of what they were trying to convince us of, we were already convinced. It was still fun going through it. At this point in the game,usually you're hearing what you already know anyway. But if it's expressed in a new and fresh way, it kinds of gives it a little bit of new life.... one thing about the overnight that was nice...you felt like we had plenty of time. I was able to keep quiet the whole first day, knowing I would get my time the next day.*

> *I didn't spend the night there, but it was really interesting and it was a good team building. I don't know if that was their intent, but it was an opportunity for us to team build. We got together in different groups, those of us that weren't so good a math, didn't think we liked it or whatever, and that was a good two days. {another member adds} " And we changed groups too, with each activity we could change and work with somebody else, that was nice too. It gave you an opportunity to meet the other [people] -- 'Math bonding!'" {another member adds} "Elmer's glue!*

> *I...came for those two days. The math was good, the food was good, the space we were in was good. We didn't have to drive for once in a million years. That for me was the best.*

> *I think one of the things that had the biggest impact on me was our time [in the retreat(?)] and maybe that was the longest stretch where we really did math.*

> *We spent time with each other. That was the turning point for me. I didn't want to go at first. Then I got razzed by everybody saying that I was going to go for a week-- "They're just a bunch of math geeks." But it turned out really well. The outside world has a very different view of math.*

> *Also the one where we were at the PALMS Institute where we did that pattern block thing, was a bit of a turning point because it was the first time on the Math Team that we did any math together.{another member adds} I keep wishing we'd do that again. {another adds} I loved that!*

*Looking back on the retreat and the math thing because I came in about that time....It was familiar, the things that we were doing, so I didn't feel like I was learning anything at the time, but it made me deal with the way I felt as a learner and I really needed to do that because math was not a comfortable thing when I was growing up and I didn't realize how much I had left over from that.*

*Think about it. how we learn and do math or teach math, you have to think about it in a very different way than you're used to thinking about it and be on the other end of it. I found the workshop very guided. I had a very similar experience (to the last speaker). I liked math as a kid but there were parts that I didn't really feel comfortable with and also the group stuff, especially in the beginning, that kit problem with the pattern blocks. I haven't figured that one out yet.*

## Mathnet

In searching for ways to increase contact and communication with each other, members have begun to use the computer Mathnet. Nearly all members now have access to Mathnet, on home or office computers, including several laptop computers purchased by the project. The interruption of the Mathnet during the recent state Department of Education reminded several participants of how quickly they have come to rely on getting messages from other users.

*I think that Math Net has been tremendous piece of this for me, this idea that I can link up with somebody at any time, that these people are out there for me to communicate with.*

*I was just getting turned on. I still have a latitude and longitude of questions hanging that I want people to back to me on. I want to hear more about it. And I think that has been a wonderful part. I can't get over how I was first resistant and then ,"WOW, this is go great.!"*

*My involvement even in the big team has forced me into doing things like managing the computer, actually start to get out there and explore and communicate to other teachers through it. That's been an experience.*

*Almost everybody is on the math net....most of us in this group.*

*I really like [the math net]. That's a source of support, too.*

*If you have a question or a problem, you can [put it on the math net].*

*At first, I didn't think it would be so great. "So what, I can just call, big deal. I didn't think it would be such a neat thing. Then every morning, I check messages. And I do it still every morning.*

> *When I've had a problem [about scientific notation], in fact, the teacher that I work with said, "Well, you're on Math Net...now you go home and call Mary Jane, call the rest of those folks and you ask them what it is because I know there's something." So I did. I sent it out globally. The insight I got was no better than what I already had, but it was interesting. That's not negative....Sally Spencer had a student in her class that wrote me what her impression was --this is how she saw it. It was real interesting that not only was I getting responses from some of the folks we work with but from students.*

## IV. Tasks

In the focus groups, participants discussed the two major tasks that they have undertaken during the year, reviewing and adapting the standards and working on research projects in their classrooms and agencies. This section emphasizes the process of the team to date, since a first draft of the standards has only recently been completed by the product coordinators, and members have not yet written their reports on research projects.

### Adapting the Standards

A discussion in one focus group focused on the satisfactions gained from debating the standards with each other and coming up with ideas as a group.

> *Actually for me the most memorable thing was when we first started writing up the standards and it was clear how smoothly we were working together and how creative and exciting it was. It was working so well with three of us I wasn't at all happy when I hear we were getting new person. But she just kind of fit right in, so that worked out just find... and we picked up a few others and we seem to have kept that real positive energy and creativity.*

> *I'm thinking about that energy. I remember, poor Judy was really scared the first time she came to visit. We would have been hammering this, but we always came to an agreement....because we al have different beliefs, but we always walked away rom it all agreeing and we always came to terms. If somebody were just to walk by, they would have thought that we were really arguing or something, because there was such a high energy level about it.*

> *To me, it just helped clarify my thinking. It was wonderful. It was a process where you were never battling,you were stating your views and they were stated real clearly and you listened and when we actually came t the consensus, I was often happier with the consensus than I was with the original view.... the consensus was not just giving up things that we cared abut, it was really clarifying things that maybe we hadn't thought about. That's what made it so exciting to me. It moved me personally forward and hopeful it did for everyone else.*

Discussion in a second focus group:

> *I wasn't crazy about it [working on the standards] in the beginning.*
>
> *It gave us a common language and a common theory no matter what our math background was.*
>
> *I didn't want to do it at the beginning and just thought of it as so much work, a very overwhelming feeling by everything, being thrown into PALMS and the Math Team and ...trying to understand everyone and everything that was going on, plus all the traveling. It was a lot for me. But as it evolved and seeing one of the drafts before the final, it's definitely worthwhile and seeing what's coming of all of it and the projects. I'm not complaining any more.*
>
> *It sort of feels like it was a necessary evil. Because for one thing, I didn't find the NCTM standards easy to read and I don't think I would have read them if I didn't have to respond to them in the work group. I wouldn't have given them the kind of attention that I did. Once that was over, I finally had some sense of what the standards were and with all of our chat about the standards, Mary Jane had given me a copy last April or May, and I didn't read it until December when I had to. I think that made it worthwhile. It was real tough doing that.*

One group discussed the beginning of the project, when they worked on the standards, and their wish for clarity. While some lack of clarity was related to lack of communication or difficulties in organizing a large, statewide group, other confusion, according to several participants, seemed to be a part of the process.

> *I would have liked a better idea, at the time, about what we were supposed to be doing. It wasn't real clear to me what we were doing.*
>
> *I think in the PALMS,... I would have liked more clarification about where the two projects overlapped and where they don't I was much more clear on the math team project than I was on the PALMS.*
>
> *I kind of feel the same way. It wasn't very clear at first. I probably wouldn't have read all of the standards, had I not had a reason or a goal. It's kind of hard to make something clear when it probably needed a life of its own. It probably would have been hard to set it up better in the beginning. That first meeting, Oh, my goodness what are we going to do? Shouldn't we have done more? I think I often feel that way. The structure, the way the meetings are run are great. It worked. There's been enough to get us here.*

At this stage, participants are exploring the connection between standards and the projects as they work through the research and analysis of their projects. Several noted that their projects grew directly out of their work on specific standards. Other effects are less direct. One member commented that studying the standards has resulted in her challenging her students more.

> *For the standards I read on the hand on and getting more technology in the classroom and that kind of thing. My project is on manipulatives.*
>
> *When I saw how math is communication and got to thinking about it and I realized that, what I'm doing is journal writing and I thought, "Why can't we do that in math class like you do anywhere else?" Also making connections. I thought, "If people could starting talking about it, really writing about what they think, it would bring more clarity to what they're learning."*
>
> *Mine were totally connected. It was my talking to one of my colleagues back at my center that got her interesting in coming in with me on a project that we're really looking at the problem-solving standard. And without the standards as a focal point, I really doubt highly this would even happen. My particular project and changing our EDP in our center, our adult diploma program. I think it was a terrific catalyst.*
>
> *My project was breaking my class into groups and the reason that I did that was to work on communication. There was also another social side, which was to see if the students supported each other in their learning. It was because we've been talking about the standards and because I had gotten excited about some of the cooperative learning things and I thought in groups, that would be the opportunity to do that.*
>
> *I did the statistics and probability one for the ESL and I feel very strongly about probability and statistics. Now my group is not learning the language of statistics... but they all learned that data analysis helped Bonnie write some of the questions for the learner interview and they're playing with all of that. They 're a very multi-level group. Some that are just learning these multiplication and division, some that are doing much more advanced things. And the one that has really got it the est, all these things we've been doing, is one of the beginners who is just doing multiplication and division. {Would you have thought of doing statistics?} No, I never would have.*
>
> *I think the standards makes us challenge our students more than we ever though of. If you look at adult ed math interview, it's stuff that we were doing 25 years ago. I think of my project, teaching algebra to somebody with dyslexia who reads at the 5th grade level, is very concrete learning.*

## Projects

Members of the team are at different stages of their research projects. Most are finishing the work in their classrooms or agencies and are thinking about and discussing their work with others on the team. This study was not designed to gather in-depth information about research projects but rather to gather information from participants in the midst of their work about their insights and problems.

Several identified "just getting started" and "zeroing in on a project" as the most difficult part of the research project. Once the projects got underway, members report that they have become very excited by students' responses and about sharing their progress in the working groups.

> *In terms of my project, to be honest, it's actually better than my wildest dream. I didn't even want to do a project, because I didn't think I had the time to do it. I was kind of coaxed into it, and I hate to fall flat on my face. I was pretty convinced that's what was going to happen with this project, but so far it's been a very pleasant surprise. It's going really very well. I took a copy of it [to] the head of our ESL deparment [and she] did it herself. We laughed about it for about 20 minutes....hopefully we'll get some good results. It's just started but it's been a very good thing and we're getting a lot of support. We gave it to my boss, who actually had a good time with it. He's very enthused about it. This is good, the way to bring him on board, which I didn't expect.*

> *I've never used manipulatives in the classroom and just this year I'm trying to teach myself first because it's a whole new concept. Considering my age, they were never used for anything. My students universally have such a difficult time with equivalent fractions and the decimal and decimal equivalent fractions. Every students tha comes through my classroom has a problem with them and my project s seeing if they can more readily understnd that equivalency [by] the use of manipulatives in different ways. I can't say I've gotten too far. It's all in my head so far. Any time I'm all ready to work with a student, she or he doesn't come in, but I haven't given up yet, because I think it would accomplish a great wall for my students, since they seem to hit a brick wall time and time again....when you have adults that are 40, 50 years old coming back because they've lost their jobs and have t have a GED in order to be in the training program, just trying to introduce them to the idea of manipulatives, it's different. They thin it's child's play. You relaly have to approach it in a way that makes it seem something that will help them corss over the bridge. I find the whole thing extremely interesting.*

A vignette illustrates the use of the working group, the ways in which an experienced mathematics teacher is tapping new sources of information about learners' interests and responses, exploration of the standard relating to math as communication, and questions that the practitioner now has about how to pass along her findings to colleagues.

### Vignette - Journal Writing in a Math Class

One teacher introduced journal writing into her math class. She finds that she gets specific feedback in writing about how students are using the materials and how the math class relates to their lives. In writing to them in their journals, she finds that she is learning. She has brought to her small group the question of how to communicate with another math team member and others the feedback about the use of manipulatives that she is getting from her class, which is valuable even though it is not the specific focus of her project.

> *I'm still trying to figure out how to make this connection. We were talking a couple of weeks ago about. I'm doing journal writing, but I already use a lot of manipulatives in my classroom. So it's interesting because when I get feedback, they'll say, " I really like this class." We're doing probability now. One of my students was saying, "I can't wait to roll the dice again next week, I'm a gambler." So it's like getting real positive feedback about my sing manipulatives. I've always gotten general feedback, but it's nice to see it in writing.*
>
> *I need to share that information with Deborah. She's doing work on manipulatives and trying to decide whether students like it. How do I make a connection with her , somehow share my project with her, that says, "Look at the feedback I've gotten every tie I've used manipulatives" We'll do cut outs for triangles then they'll write me that they tried this at home with their kids....that;s not what my project's about, but I need to share that information. One of the questions we had at our small group is "How do we share that? " How do I know somebody else is doing manipulatives that would value what my students are saying in the journal writing that I'm looking at. We had a good discussion about it.*
>
> *They're not writing as much as I'd like for them to write, but I'm writing at the same time, which is a real interesting learning for me, because I don't do journal writing and every day when I sit [down with] them at the end of the day, I've been writing. We're all learning.*

**Observation/Reflection.** Many of the examples used in Section I, Impacts (and in other portions of the report) relate to members' experiences during their projects. In order to understand better what is happening in their classes several team members are exploring new ways to collect information about the dynamics of their classes and and to think about the effectiveness of their teaching.

> *I'm saying, "Now I understand what you were trying to say." How do you when you're in it also see it objectively to say, "This is what worked and this is what I didn't do that worked. I think taping has been very helpful for me in that. Audio. I would love to video...then really see what happened in that class that day, but I don't have the equipment. Some of my more religious experiences have happened in my car listening to the tape of my class as I'm driving home that day, or coming in the morning.... but until I'm away from it, hearing it, that goes right by me, I had no idea what happened in my class that day.... and in the beginning when it was suggested to me to tape my class, I didn't agree, I felt as if I knew what I was doing. But I tried and my poor students are now going --At first they feel like they're on, and*

> *I tell them I'm the only one who listens to it. Now they're more comfortable. {another speaker adds} I learn a lot from watching what goes on in her class. It's really influenced me.*
>
> *I think one of the things that came out of the reflection piece. I think every teacher needs time in their day to reflect and review what happened in the classroom if they're really going to be effective on an ongoing basis. And it's made me want to go to my supervisor and advocate for all instructors to have that time. It's part of preparation is reflecting on what worked and what didn't, instead of every day just going in there , and whatever happens, happens.*
>
> *If I was going to change anything, I think as a part of the research project there would be an inside observation of what we're doing involving our research so that we can get immediate feedback and discussion. That happened for me recently. It wasn't planned to be that way.... she was observing for this other thing and I happened to casually mention something about, "Well, I'm really having difficulty with this particular issue and then we ended up staying and talking two and a half hours....I felt like I needed somebody there observing what I was doing in terms of my research, and it wasn't until that happened that I really felt like I got my voice as far as the research development.... I told her my big issue was that it it's not working I can figure it out, but when it's working, I don't even know what to ask. I know they've been working all the way through this to reflect and analyze about what happened in our classrooms and for some reason I was shying away from really getting the microscope out.*

**Conflicts – Time and Program Requirements.** As with other aspects of a time and energy intensive project such as this one, working out schedules and finding the time to do the work are ongoing problems. Several participants also described conflicts caused by their need to operate within an examination schedule or external requirements of students to demonstrate performance on standardized tests in order to remain in the program.

> *The problem with my project is time. I didn't want it to take up my life, so I said, I'm not going to have the project piece. [The agency] will get paid for the project piece, so I just have to do it on work time. The problem is that the rest of my work is taking up my time, so I haven't done as much of the research stuff as other people have. I'm not as far along as most.*
>
> *I feel my reflection time has been minimal, because it's not the only thing we're doing. It's not like you're going for your masters or your doctorate or something and you're in school full time. You know what I mean – life goes on.*
>
> *For myself, different times of the year. It would be less for myself. Going into June is like the pressure's on for outcomes, both on the agency level and on the student side. It's June. Everybody's graduating. They want to graduate. So they don't want to be*

> *exploring, writing their own problems. Get that book. "I got to study. I got to pass that test next week." Timing, it's just the way it fell. You accept it but it definitely could have been better.*
>
> *Some of the frustrations come from similar things to what were saying. In the class that I'm working on, I have a good and a bad thing. I have four students. If the come consistently it's wonderful. The are true ABE students that aren't moving anywhere. However, there were six and two of them did move! Then there's the choice. Do I continue with the project or do I do something else today because I don't want two people way behind. This whole attendance problem.*
>
> *We've got external pressure from agencies telling us that people have to make x amount of progress in x amount of time. Sometimes I felt too guilty to take a lot of time to do this project that was, I kind of felt it as more for me that it was for them. Like, "I know you guys want to do this, but we have to do this because I have this project to do." They gained a lot from it and they enjoyed it too.... it was good to hear [in the work group] that people had similar experience because I always felt much better after that, just knowing that I'm not insane. There is something wrong with an outside agency that isn't educated telling you that somebody has to do up three grade levels in three months.*

## IV. The Math Team as Staff Development.

Participants were asked to talk about the Math Team as a formal staff development activity, comparing it with other forms of staff development in which they have participated. the relationship to a vision or set of goals, the focus on a specific content area and projects, the formation of working groups, the opportunity to apply ideas and get feedback on an ongoing basis, working with people over an extended period of time, the opportunity to see change in their teaching and in their students' responses and the communication with teachers from around the state were major features of the Math Team. The excitement generated by learning themselves and by finding ways to engage their students on an ongoing basis has made this Math Team a unique experience for a number of members.

> *I don't think it was ever billed as staff development and I think that is what it turned out to be {another member adds} It was billed "We're going to do something" not "We're going to have staff development."*
>
> *Very active. It is really demanding. I have to do it. I don't just get to sit back and receive, it's really active. That's what makes it very effective and so profound. But its also a lot of work and I get real tired learning how to be a researcher, because I am one.*
>
> *I consider it staff development for me. It's framing a different way for me to teach math. I will in turn share that with the other teachers at the center. {another member*

*adds{ It's like an enhancer. You think of staff development as reinforcing, enhancing, whatever. {another member adds} But instead of taking six different workshops, this is just one ongoing process.*

*You leave a workshop, you're not going to be in that setting again. Here you'd be committed to this series of things and every step of the commitment, we had to report back to a small group.*

*{The same person} Workplace group is always a big group and it got to be a bit much... The mixture of small and large group I think is the big difference between [the math team] and [the Workplace Sharing group] that makes this group better...the combination of the informality of the small group and the bit more formal, structured set up of the large group is a good mix.....I also like the fact that it was more limited in the scope. In other words, it was focused in on the standards and it wasn't trying to do everything. It was focused and even then we were having trouble with focus....We set some boundaries. We weren't trying to deal with every issue that you ever deal with in your entire life in adult ed, we were focusing on the math standards and applying that to or experience and we found that it went broader than we thought....I like the idea of this whole year has had a focus, a focal point, something you an hang your hat on, so to speak.*

*During the summer [two of us] did a sample of how we would play with the standard, it's like we talked about a vision and one of the first things we did was to develop a philosophy or vision. We had a goal in mind. We knew what we were going to do and before that, they were kind of floundering. I think a lot of groups a lot of times, whether its the workplace group. You meet every month. It's nice to share but there's not a higher goal or something that we're really striving for. We all believe that we're on the forefront, that we're all trying something different and trying to make a change and I think that kind of drives us and that's why its a more effective group and we can all fail, all make mistakes, so we don't mind sharing. It is more of a learning because we are taking risks.*

*Actually to me its the perfect staff development ....there's something there that i can take back and try in the classroom right away. Or just the fact doing our projects...we're learning and applying right away, it's not lie taking a workshop and never using it. We've kind of bee forced, when we started these projects, it's like you are to try something new, something that you've never done before and that's really been good. A lot of times, staff development, you go to the workshop, then yo go home and "yea, it's a great idea, Ill try it next week." But yo never do it.*

*Another thing with staff development, you go to a workshop and you knew as much as that before you started and nothing new had been added, not because you're so bright, but just because it's something that you've done before and handled it as well as the person presenting it.*

*Another thing about this group, it also shows how little our state is. I'm not exactly clear why we have to be divided up into regions.... each becomes a world unto itself. It's really nice to be one state. {another member adds} "That's a good point, because originally it was going to be an east and a west. I'm kind of in the middle so I never fit anywhere.*

*The longevity of this. And we are all beginning to get a sense of what we're doing and what our work is and what it takes to get it done.*

*I wasn't sure if your question was do we recommend this as a staff development activity for someone else or some other time and my answer would be "no" unless it was exactly the same thing. You can just say, "Okay, get together in teams and be social to these teams no and that will be your staff development." there was something that worked about this and it would have to be in the other thing.*

*I think there was a true commitment to what we were doing here as opposed to just someone saying, "Here's a project, now get together and do it. It's something that all we truly believed in as opposed to just being told to write up something or do something.*

*I think it's a great form of staff development. You learn a lot in a focused area. It's difficult if you , say, have 20 hours a year of staff development and you .e going to use it all on this. I felt a little bit like I neglected all my other areas this year because I've been a little bored in math. I didn't really go to any staff development this year, writing, but its changed the way I teach social studies.*

*[In] my participation in Project PALMS, I observed this [learning] happen by going to a four session workshop conducted by the PALMS teacher at the high school....It was amazing for me to watch these teachers from the schools come to the first meeting, kind of looking at it, seeing what it's about, getting paid to go. The were there listing to their objections, objections that I heard myself having back some time ago....Going to the second one after they've done a little bit of the hands-on stuff, kind of a little bit more excited about what they're going to do. Unit the third one...where I heard one of the teachers who was at first very resistent to it... saying, "It was amazing when I read that paper by that woman -- fractions...She said," You know, next year I'm going to try that and to hell with the book!" And I thought, '"Listen to this" It was so wonderful, then, she was looking forward to the next meeting.... I realized then like Donna said, you can't go away on a one day workshop and start changing the way people are going to view [math]. It needs to be this, come and come.*

## V. " Next Steps" - Recommendations of Participants

In thinking about the Math Team, members began to formulate recommendations on a number of levels, from immediate next steps to larger questions of sharing their findings and expertise to replication of a team concept. Participants were interested in finding ways to take the excitement and support back to their centers, to communicate with others. A number expressed concern about the future of the team when grant funding comes to an end.

> *I'm doing journal writing, but I already use a lot of manipulatives in my classroom....I need to share that information with Deborah She's doing work on manipulatives and trying to decide whether students like it. How do I make a connection with her, somehow share my project with her that says, "Look at the feedback I've gotten every time I've used manipulatives." That's not what my project is.*
>
> *It's really scary to think when the money goes, this will all fall apart. I don't have any answers for it.[another member adds} It's one of the most exciting things I've ever been a part of. It's just been exciting. {another adds} And we're just getting started.*
>
> *[Mary Jane] said she has been looking for more money. But it is scary because we like all so much to think and I'm not sure without money that we can keep it together.*
>
> *Such excitement in a short amount of time. It's really hard for people to make changes in how they teach. This has done major changes in people that are then going to go out and spread the word. We've got prophets.*
>
> *We should do a road show. We need to do workshops and observations. For the future I see us continuing to learn as a group, but somehow bringing it back and helping others.*
>
> *[Discussing possibilities for training others in an agency] But if you have staff meetings or whatever and for a while, development days or whatever, to make math something that you would offer. I'll do something for six or eight weeks, or eight meetings whatever it is, on math.*
>
> *Maybe in another setting we could do something about it [outside agency requirements hat students made specific, large gains on the TABE to continue], maybe that would be the jumping off point for another group of people to really work with some of the groups outside of educational groups that are requiring us to do a certain amount of work -- so that they have an idea of what it is that happens in an ABE classroom. {another speaker adds (?) Maybe if we put all this stuff together. It won't change it in the short run. {another} Well maybe even in the long run there's hope.*
>
> *I hate to admit it but I'm thinking that the next thing that we've got to do is Mary Jane's kind of things. We've got to go to Network 93 and we have to have workshops that brings the standards to life for the other teachers and we have to make ourselves available and ... spread this to some other people. But we also need each other*

*because we have a history that got us to where we are that's going to be very precious to us.*

From a discussion about materials and training other teachers.

> *What I would like to see is almost like the GED Priority Math, but call it ABE Something, were it's teacher notes and suggestions, types of lessons, types of activities, actually specific activities, which is what I thought this was going to be anyway. Maybe it will be.*
>
> *There's not a lot of materials for us to use and I'm constantly looking for materials, and I look at the K-12 stuff and it's good ideas, but I've got to rework them for adults.*
>
> *[We] went to a workshop at SCALE last spring and I remember [she summed it up. she said, "The best thing about the workshop was the packaging." I think what would really make a difference is if we had a workshop were you give the person three of those zip lock gallon size bags and in each bag is a lesson and the manipulative for their classroom. they sit there and they do that and they open up the next bag and there's a lesson and they do that. And they go back with three distinct lessons and everything they need to do it. And then I know, because it works for us, then their own ideas get generated. Then, maybe we tell them to come back to us _ couple of months later with a zip lock bag for us. I think we have to make it pretty easy. {another member adds} And really hand-on. More an more the teachers, at least our teachers, are asking to use them if there were more They would like to learn how and they really feel they can't do it till they learn.*
>
> {end of discussion}********
> Discussion in another group
>
> *I never worked with those type of math manipulatives because I wasn't a math teacher. I was a math major. It was a learning experience for me and then how could I incorporate this into my classes if I had no concept. What's this good for? What can I sue it for? {another speaker} And even maybe playing with both manipjlatives and the standards a little more instead of discussing them. {another speaker}In terms of another team we're going to organize, I would recommend that this start in maybe February or March, spend the spring exploring and getting ideas and exchanging ideas, and then in September actually implement their project plan at the beginning of the school year, because I thought it was unfortunate to be so are into patterns with my students, and then all of a sudden try to implement a project plan. That was a disadvantage.*

# The Problem Solver

A Math Newsletter for Adult Educators Vol. 1 No. 1 Fall 1992

## The Standards In Action

I volunteered to write an article about the National Council of Teachers of Mathematics ***Curriculum and Evaluation Standards for School Mathematics.*** Because I didn't know anything about them. My first admission must be that I am not a greatly experienced math teacher: I have worked mostly teaching ESL in classes where questioning has been the central activity. According to the standards, this questioning serves well in math classes.

My first opportunity to teach math and to realize how important and entertaining it can be came when I got a job in a program which provided on-site building-trades training. This program took abandoned Boston residential structures, rehabilitated them and returned them to the city to sell. Classes took place in the early morning and the rehabilitation work filled the rest of the day. I loved teaching here, where conversations and instruction involved passing tools back and forth, carrying materials, measuring and placing, asking for a hand or for advice, building things. There was no question of having to create manipulatives - or having to create a context for the problem-solving. They all learned carpentry while learning English.

Not everyone , of course, is a carpenter or interested in the measurement and calculation required to build a set of winding stairs or to estimate the amount of sheetrock needed to finish a hall. The point is simply that

(See Action - page 3)

## The Editor's Angle

WELCOME! to the first edition of The Problem Solver.

The Massachusetts ABE Math Team has funded this project to establish communication between all math instructors on pertinent math topics. It is our hope that each of the year's three issues of The Problem Solver will focus on a specific topic, such as Family Math, Workplace Math, etc.

This issue, the topic is the national ***Curriculum and Evaluation Standards for School Mathematics***. Our discussion of the Standards is meant to introduce readers to the main issues and ideas presented therein.

We hope to have regular sections and features in the Newsletter, and with any luck regular contributors. We are open to comments and suggestions and welcome any submissions of cartoons, questions, activities or articles. For articles, however we suggest you call us (413-774-3182 - Tricia Donovan, F/HETC or 413-538-7000 ext. 586 - Bill Arcand, SABES) to confirm the main topic of the upcoming issue.

Any points of interest for our bulletin board can be sent directly to Tricia Donovan, c/o F/HETC, One Arch Place, Greenfield, MA 01341 or sent via Math Net, ABE (Conference: Standard, Document: Bulletin).

The Problem Solver is meant to be an open forum, so we sincerely hope to hear from everyone.

–TND

**EDITION FOCUS: THE STANDARDS**

## Standards Overview - What to Teach, How to Present and Evaluate It

As the Industrial Age ends and the Information Age begins, the requirements for math literacy change. In response to this change and charges that U.S. students are at risk of falling behind their international peers in MATH comprehension/skills, The National Council of Teachers of Mathematics established a ***Commission on Standards for School Mathematics*** (1986). This commission was directed to "establish a broad framework to guide reform in school mathematics in the next decade." (These standards are currently being reviewed and assessed by the Mass ABE Math Team to create a standards document relevant to adult education programs.)

The standards are meant to outline a) priority topics for instruction as well as b) instructive approaches to those curricula and c) methods of evaluating the effectiveness (on students and program-wide) of such instruction.

The publication Curriculum and Evaluation standards for School

(See Standards - page 2)

### *Don't Miss...*

Activity Pages ................ 5-6
Book Corner ................ 9
Field Operations ................ 10
Perspectives ................ 2
Points of Interest ................ 4
State Lines ................ 3
Student Segment ................ 7-8

# Perspectives

*A column of practitioner musings. Readers are invited to share their own experiences teaching or learning mathematics, or to respond to this issue's story.*

I keep my ears perked and my eyes wide. I am an investigator, trying to uncover the role of words and language in math class. In the spirit of the NCTM standards which emphasize math as communication, I'm both documenting what occurs and trying to create opportunities for the students to use language to explain math.

In my teaching journal, I have vignettes that captured moments where I was kept from being a directive teacher's aide by my inability to converse in another language. In this one, I am again left out. Andrea and Tanya were conversing in Spanish at a time when we most of the group was working individually on fractions from xeroxes, the two women took a break eventually to ask me a question about math, the first time I had a clue that they were even on the same subject as the rest of us.

> *Tanya talks constantly. Andrea and she had one math-related conversation about percents. Andrea was aking how to calculate percentages on a calculator. She and Tanya, apparently, belong to a church or churches where they are expected to pay a tithe. Andrea said up until now she has just given a standard amount, but she is probably underpaying. Shelly [the other teacher] brought a calculator over and showed Andrea what to do. Then Tanya offered something like a shortcut in which for a $10.00 purchase she knew that $9.00 of it is hers to spend. Or something like that. Most of the conversation was in Spanish.*

This vignette particularly raises some important questions about how to capitalize on the women's interest and knowledge. When we get to percents, how can I best use Tanya's facility with this area to help others? Should we have shown Andrea other short-cuts to figuring 10% or been content to show her on the calculator? I want to follow up on this authentic use of fractions, yet I'm worried that we could end up spending more time on comparative religion than on math.

–Martha Merson

Any suggestions? Write or call The Problem Solver through Math Net, ABE (Conference:Standard, Document: Bulletin) or contact Tricia Donovan, c/o F/HETC, One Arch Place, Greenfield, MA 01341 (413)774-3182.

+ - * / = π + - * / = π + - * / = π + - * / = π + - * / = π +

# Standards

(Continued from page 1)

Mathematics includes curriculum standards for grades K - 4; grades 5 - 8, and grades 9 - 12. In addition, there are 14 evaluation standards. All are "meant to be used when considering curricula problems and evaluation standards".

Believing that today's math students must be able to "ask questions", assimilate unfamiliar information, work cooperatively and understand the complexities and technologies of communication" in order to "set-up problems with appropriate operations, use a variety of techniques to approach problems understand underlying mathematical features of a problem and see the applicability of mathematical ideas to common/complex problems, especially open or poorly formulated problems."

The Standards are uniquely suited for transference to adult education programs because of their emphasis on math as language, "doing" math, and integrating all academic content areas. With the inclusion of student activities and focus discussion directions for each Standard, the document becomes an extremely valuable resource for any class where math is communicated. (All Math Team members have copies of the Standards, or they can be purchased for about $25.00 from Dale Seymour Publications or NCTM).

–Tricia N. Donovan

January 15 is the birthdate of Sonya Kovalevski, a researcher in differential equations and algebra.

# State Lines

You know how sometimes there's a feeling in the air that the time is right for change? That's how many of us feel about the way math is taught and learned in ABE/GED/ESL classes. Several projects have recently begun in Massachusetts and will serve as rich resources for the field as we all consider how to improve ABE math instruction. Here's a quick rundown of some of them:

**Project PALMS** is a five-year Massachusetts Department of Education systemic change initiative funded by the National Science Foundation to improve math and science education. In this first year, the six ABE demonstration sites are: the Halo Center, Holyoke; Worcester Adult Learning Center, Quinsigamond Community College; New Bedford Adult Learning Program; the Haitian Multi-service Center; and Central Berkshire Regional in Dalton.

**The ABE Math Standards Project** funded by the National Institute for Literacy through Holyoke Community College, is the focus of the ABE Math Team's work this year in order to adapt the NCTM Standards to adult learner settings. Twenty teachers are on board.

**The ABE Math Research Project (RABEM)** is documenting the current practice of ABE Math instruction in order to provide information on our strengths and guidance for what might be changed. World Education received a grant from U.S. DOE (OERT)

MATHNet is a free telecommunications network that's beginning to catch on as the communications vehicle of choice for the math team.

VolUME (Volunteers for the Ultimate Math Experience) is new six-hour math training for Commonwealth Literacy Campaign literacy tutors.

The SABES Math Jump Start Kit is a set of $200 worth of classroom materials that any ABE program can borrow from their SABES Regional Support Center.

***The Problem Solver*** is a SABES dissemination vehicle to engage as many teachers and students as possible in a very young and energetic wave of reform.

If you're interested in any or all of these projects, pick up a phone and give a member of the ABE Math Team a call.

Mary Jane Schmitt

# Action

(continued from page 1)

learning math is not an isolating and punishing experience intended only for the brainy, but is a form of thinking and communicating in which we all can participate enthusiastically if given the chance to learn in a pleasant and meaningful way. Instructors and trainees often discussed possible approaches to solutions not only because something needed to be built, but often just for the fun of it.

Currently, driven by my experience in the home-building program and also by student demand, I urged that a math program be developed to complement the language instruction. As our math program has developed, students have clearly reaffirmed their eagerness for math instruction. I will never forget asking a man nearing sixty years old who was learning to add and subtract why he wanted to learn math, and he answered that it made him feel more like an adult. Though I can barely begin to understand what he meant, it was clear to me that he had long felt excluded from a world of thought and activity which seemed to be beyond him...

In finding ways to engage this man - in conversation, exploration, and illumination about the clarity and beauty of math as it applies to his life, I can relate to the Standards. Putting to the test not so much what people don't know math-wise as what they do know is a great first step toward getting people started in the math process. Along with the satisfaction of independent and silent calculations, there must be an open and shared process. Posing questions and probing for answers, and not just to arrive at the answer, but to learn a new idea or at least a new twist at every turn in the road, and to talk about it.

Read the math standards, or read a few articles about teachers' responses to them. Mainly, I think their importance is in their encouragement of the obvious, which is that math is not a four letter word, and should not be relegated to dark and esoteric locales. It is, rather, a form of dialogue open to everyone if the invitation to join in is extended with a true sense of welcome and curiosity. What the standards do is remind and affirm that our inclinations as teacher to get students engaged in and curious about their math work are in fact (no surprise!) meritable.

–Tom MacDonald

## Points of Interest...

**Math Research Questionnaires:**
Itr's not too late to send in the RABEM Questionnaires: Please send program and instructor questionnaires anytime to: Bonnie Mullinex, 285 Hills House So., UMASS, Amherst, MA 01003. Program questionnaires are especially important.

**Conference**
March 21-24, 1993, Conference on Technology and Education, 10th International, MIT Cambridge, MA Contact Michael Thomas or Cheri Chase, College of Education, University of Texas, Austin, TX

**Spring Conference**
March 9 (K-8) March 10 (6-College) Wallingford, CT, Choate Rosemary Hall. ***A Pattern for Mathematical Succcess Assessment, Instruction, Standards*** offered by ATOMIC. For further information call Tim Craine, (203) 297-2281.

**Congratulations!!**
**Esther Leonelli, Cambridge Community Learning Center, MCAE Adult Education Teacher of the Year**
**Mary Jane Schmitt, Bureau of Adult Education, 1992 MCAE Special Recognition Award**

**Immigrants**
Maureen B. Martel of the State Immigrant Unit wants to share current information regarding The Immigration and Control Act particularly as regards em-ployer requirements and discrimmination protection. If you are interested in this information, please call her at 617-727-7888 or write her at The Executive Office of Health and Human Services, Office for Refugees and Immigrants, 2 Boylston St., Boston, MA 02116

**Have any news for Points of Interest?** Our next issue will be out – April 1, so any workshops or other scheduled event information should be for the April - Aug. period. You can contact The Problem Solver through Math Net, ABE (Conference:Standard, Document: Bulletin) or contact Tricia Donovan, c/o F/HETC, One Arch Place, Greenfield, MA 01341 (413) 774-3182.

## The Battle Hymn of Math Teachers

Joanne E. Meldon of Pittsburgh, PA had a roomful of math teachers belting out this song at the '92 NCTM conference in Hartford, CT. It embodies the same spirit of committment and enthusiasm for teaching math as do The Standards.

Our eyes have seen the beauty
Of the math we love to teach!
Facts and figures are our forte
Relevance is what we preach.
Love of math is what we strive for
While success we bring to each.
As we go teaching on.

**Refrain:**
Glory, glory, make connections!
Mathematical connections.
Glory, Glory, make connections!
Our subject really counts!!!

Plato saw them in his solids.
Descartes found them graphing pairs.
Fermat found them with prime numbers
Math connections everywhere!
Lieniz found them taking limits
Cantor saw them way out there.
And we'll go searching on.

**Refrain**

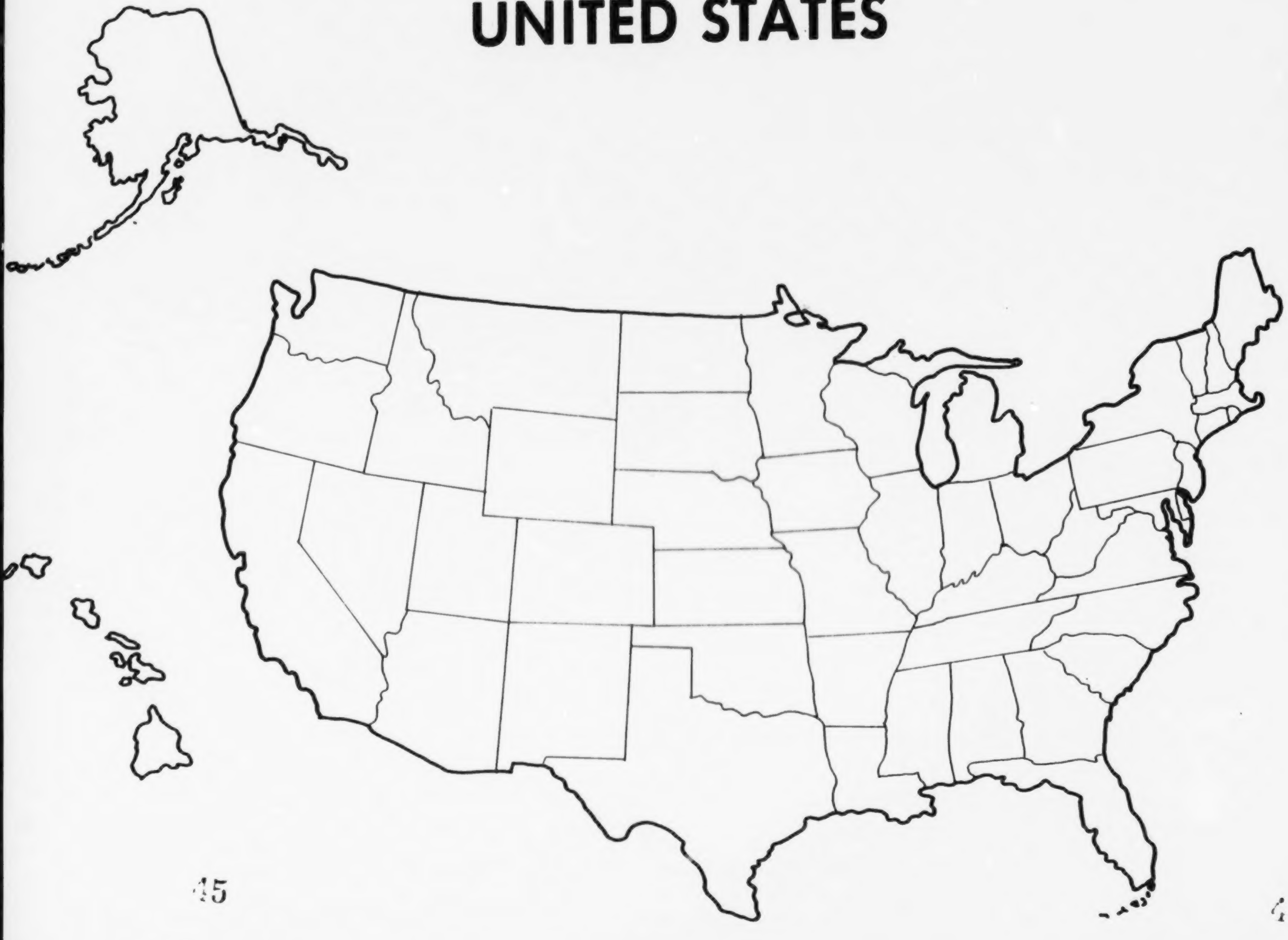
Pi, I, and E we cherish,
Σ, ø, to us aren't Greek.
"There exists", "for all", and "such that"
is the way we love to speak.
We'll accept the greatest challenges.
Truth and beauty's what we seek.
As we go marching on.

**Refrain**

And now the session's over,
We must go our separate ways.
But the beauty of mathematics
Bonds us strongly everyday.
Here's to joy within our classrooms.
May we solve it come what may!
As we go teaching on.

**Refrain**

# UNITED STATES



**Activities to go with this map are on the next page.**

# New Methods with Numbers

*Barbara Goodridge of the Lowell Adult Education Center, originally designed the following as an ESL activity after discovering a list of the USA's top 20 city populations. The activity, integrates geography and math skills and can be used to teach a variety of math principles. Use the map on the previous page with the following activities.*

### Population of the 20 largest cities in the U.S.

1. Ask the students to name large cities in the United States that they know of or have visited. Ask them to guess the population of some of these cities and write their guesses on the board.

2. Make index cards for the 20 largest cities giving the city and state name and the 1990 populations of that city, one on each card.

3. Working in groups of 3 or 4, give each group a worksheet map and the cards. Ask them to order the cards from the largest to the smallest by populations. Then ask them to label each city on their map within the appropriate state boundary.

4. Next, work with the entire class to record the results on the classroom wall map. Ask for someone to name the largest city and read its population. If it is agreed that this is the largest city, have someone pin its card on the map in the appropriate place. Continue in this way until all of the twenty cards have been placed on the map. This is a good opportunity to emphasize pronunciation of the numbers and names of cities and states.

5. Some possible questions to focus their attention on the locations and populations of the cities:

- How many cities have populations of more than 1 million?
- Which cities are very close on the map?
- Which states have more than one large city?
- Which cities are in the western part of the U.S.?
- Which cities are in the eastern part of the U.S.?
- Which cities are in the northern part of the U.S.?
- Which cities are in the southern part of the U.S.?

Populations of the 20 Largest U.S. Cities

| City | State | Population |
|---|---|---|
| New York | NewYork | 7,567,146 |
| Los Angeles | California | 3,624,206 |
| Chicago | Illinois | 2,852,041 |
| Houston | Texas | 1,697,301 |
| Philadelphia | Pennsylvania | 1,608,942 |
| San Diego | California | 1,143,032 |
| Detroit | Michigan | 1,056,180 |
| Dallas | Texas | 1,043,947 |
| Pheonix | Arizona | 1,003,800 |
| San Antonio | Texas | 974,099 |
| San Jose | California | 801,296 |
| Baltimore | Maryland | 759,127 |
| San Francisco | California | 745,573 |
| Indianapolis | Indiana` | 741,712 |
| Jacksonville | Florida | 649,437 |
| Columbus | Ohio | 645,256 |
| Milwaukee | Wisconsin | 642,860 |
| Memphis | Tennessee | 628,329 |
| Washington | D.C. | 628,309 |
| Boston | Massachusetts | 590,703 |

***Editor's Note:***

We enjoyed this activity so much, we created a few additional ideas for using the list, map & Barbara's questions:

1. A) Using the ordered list of cites in #3, find the median population, the mean population and discuss why they are different.
   B) What's the population of your town? How can you compare it to the largest city? (Subtract, ratio, fraction...)

2. How can the populations of cities in each section of the country be graphed?

3. What, if any, conclusions can you draw from your data?

4. Draw a rectangle such that 5 cities are included within its boundaries. Who has the rectangle with the largest total population, the smallest? Who has the rectangle with the largest area, the smallest? What is the diagonal of your rectangle?

February 18th is the birthdate of classical physics founder Galileo Galilei.

# Student Segment

## F/HETC G.E.D. Class in Greenfield Contributed this Issue's Student Segment

*The following student essays were written in response to the suggested essay topic: Is math necessary or important today? How? Why?*

+ - x / = - # % *

Math is very relevant in today's society. Numbers and math are all around us.

I personally love working with numbers. But I've learned that some mathematical problems can get quite complicated. Once you learn the different formulas its not quite so bad. The math, I seem to use often are adding, subtracting, decimals, fractions, multiplying, division, and geometry. There are just so many things that consist of math equations.

Adding and subtraction are definitely two procedures I use everyday, particularly with organizing money, receiving a check, adding up monthly bills, and learning to budget your money so you can pay them all. Adding and subtracting are also used when balancing a check book.

Multiplication and division come in handy while grocery shopping too. Like when you have things that are three for a dollar and you only want one. You would use division by dividing three into one dollar. Then you would know how much one cost. Multiplication is handy in mixing up baby formula: you just add up how many ounces the baby drinks and times it by the number of feedings and you get what you would need for the day. It's great for moms who have to work and leave their baby with a sitter.

Fractions are used a lot in recipes. They're always calling for three-fourths cup of something or other. Fractions are also very helpful when trying to double a recipe or make a batch of something.

There's one more thing in math that I found helpful to know about around the house as I discovered, when I was redecorating a small bedroom. That was geometry. It helped with putting in the carpeting and wall papering the walls. It was also a great help in figuring out if certain pieces of furniture would fit or not.

There are just so many ways we use math everyday and I don't think we're even conscious of how much or how often we use it, and how important math is for us to learn.

-K.B.

---

To me, math is necessary today because I use some kind of math, whether it be figuring calculations or measuring when preparing supper. I feel math is very important, especially since the career change that I'm making will require me to use some kind of math. The career that I want to go into is either Business Management or Secretarial.

I like math personally because I like putting my brain to work. Most of the time I can figure out a math problem off the top of my head. A person also uses math on a daily basis. There is still some math that I have problems with, but I am willing to learn more.

Math is an important part of life for each individual because whether they work or go to school, or proceed onto college, every type of filed has some kind of math. I also want to learn more math so I can help my children as they get older.

-E.E.

---

Math is very necessary in my everyday life because I do carpentry. My plans for the future will also require mathematical skills.

For example, with my carpentry I need to figure out elevations of walls, ceilings, and roofs, the pitch of a roof, and treads on stairs which the bottom of your foot lays flat on.

It is also important in my job, so I can give the correct estimate on the work I'm doing, like building a hose, deck or doing a renovation of a room or a house. I use math for basic living such as balancing a checkbook, grocery shopping, and other kinds of shopping like buying a bike, clothes, cars and household goods...

So in my life, math is necessary for me in work and for when I start to go to college in the future. It's also important to I may be better able to understand the world around me.

-M.T.

---

Everyone uses math everyday without even knowing they are using it.

If we didn't use math, we wouldn't be able to buy more than one thing at a time because we wouldn't know how to add the things together to see how much they would cost, so we could see if we had enough money to get them.

I use math everyday, from the time the alarm clock goes off at 6:30. I have to make sure I have time to do what I have to before I have to get my kids ready for school. They have to be at school for 8:30 and I have to be at school for 9:00, so I have 2 hours to get everything done before we all have to leave.

When I go shopping I have to use math because I only have so many food stamps I can spend each week, so I have to add everything together to make sure I don't go over.

I use math to pay my bills too because I have to add all my bills together so I will know how much money to save out of my checks each month to pay the rent, lights, telephone and still be able to put gas in my car.

-M.P.

# Student Segment

### Student Essays cont.

Math is important because we use numbers every day of our lives in such shores as shopping, working on cars, working in machine shops, welding, carpentry, floor installing and molding.

When shopping, you use math to add up the item which you are buying. When working on cars, you use math to find out the size of a piston or cylinder wall to see if you can bore out the cylinder wall or put in new rings, or get a new motor block. In machine shops, math is used to find out the size of a part by using a micrometer so you don't let a part be shipped that is too big or too small. In welding, you use math to find out how long or how much of an angle to put on a piece of metal. In carpentry you use math in blue prints of a house or cabinets, chairs and tables. In floor installing, you use math in finding out how much carpet is needed to do your house.

As ;you can see, math is just about everywhere in our lives, so we need to learn our adding, subtracting, multiplication, and division just to make it in the world.

-G.P.III

### Student Tricks of the Trade

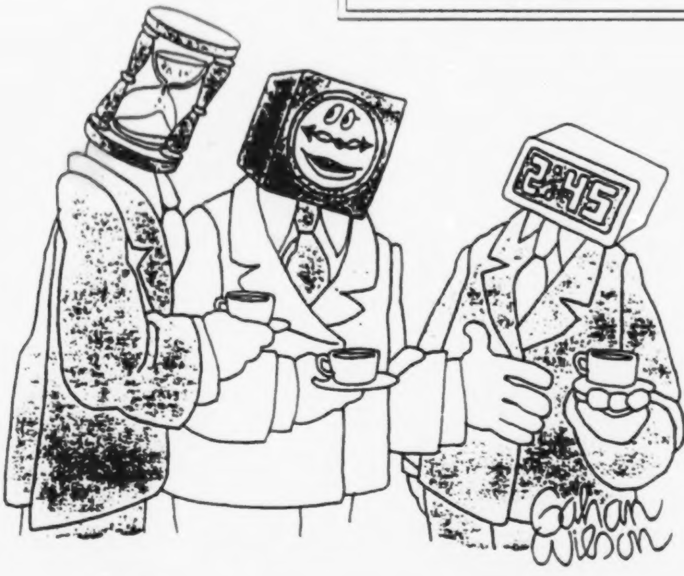
There is a trick I know for addition. It is used when someone has an addition problem and all the numbers are in a column. Take all numbers in each column and find pairs that add up to ten. Count your tens then add on the remaining numbers. See below.

```
 24 ──────┐
 36 ──────┘  = 10
 45 ──────────┐
 78 ────┐     │
 55 ────┼─────┘  = 10
 12 ────┘  = 10
+47
```

3 x 10 = 30 + 7 = 37 in units column

Timothy is now 100% older than his younger sister, Rebecca. In 1 year he will only be 50% older. How old are they now?

Answer: 1 & 2



*"Basically, we're all trying to say the same thing."*

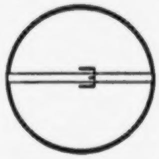
Reprinted from the New Yorker magazine.

## Word Problem

*This problem was presented in class by Michelle Peterson and Sharon Jardine. It was given to them by Michelle's uncle.*

If you put a 25,000 ft. belt snugly around "a" world, and then added 10 feet to the belt, would you be able to: A) slip a piece of paper under it, B) crawl under it or C) walk under it?

**Answer:** B

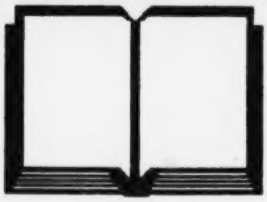


Circumference = 25,000 feet

**Solution:**
Find the diameter of the world with a 25,000 circumference ($c = \pi d$ or $^{c}/\pi = d$). Find the diameter when you add 10 feet to the circumference and subtract the smaller one from the larger one. (Approx. 7964 - 7961 = 3 feet) Divide the difference by 2, as the belt will be evenly extended on the diameter. This will create an 18 inch space under which you can crawl.

Or: As we also did in class: Draw circles; use pieces of string to show the relationship of diameter to circumference ~ 1:3 and infer that if you add 10' to circumference you've added a little over 3' to the diameter, (proportion) so if you divide by 2, you get enough room to crawl under.

December 25 is the birthdate of Sir Isaac Newton, a major contributor to mathematics, physics, astronomy, natural philosophy.



# The Book Corner

**Beyond Numeracy**
by John Allen Paulos, Alfred
A. Knopf, Publisher

In ***Beyond Numeracy***, John Allen Paulos narrates an interesting, adventurous journey of thoughts in the mathematical realm that works on many levels and asserts over and over again an attitude in tune with the NCTM Standards: math is both relevant and expressable.

Some parts of the work can be intimidating to novices (comme moi) with nearly whole pages of formulas, but most of the discussion is accessible, more often fascinating. Paulos asks "Did you ever read a mammoth generational saga near the end of which a character utters some perfectly vacuous truism which never the less resonates deeply with the rest of the book and makes you review everything in its light?" and answers, "My reaction to the formula for the area of a rectangle is somewhat similar." Paulos then launches into an exploration of areas of plane figures, concluding at one point that "whether wallpapering an odd shaped room or painting the walls of a Gothic Cathedral, you may find the area of any plane figure that is bounded by straight lines simply by dividing and conquering; Portion the figure into triangles and rectangles..." Swiftly and elegantly, the abstract is landed in the concrete.

The understandings of such diverse topics as calculus and mathematics in ethics (one of my favorites is "the prisoner's dilemma") sharpens thinking and broadens horizons for the reader. And often the concrete applications made by Paulos are relevant to adult learners. All of us, in fact, can laugh at and learn from such concepts, as "floppy digits." Professor Paulos obviously loves math with all its avenues of expression and develops the same appreciation in his readers. A mind opener!

**How the World Works**
by Boyle Rensberger, William
Morrow, Publisher, ($8.95)

With the very first curriculum standard, instructors are encouraged to "explore the relationships among mathematics and the disciplines it serves". Chief among those disiplines is science, and in ***How the World Works***, Boyce Rensberger provides an invaluable reference of scientific terms, principles and historical figures.

This book is an essential classroom resource as it succinctly describes everything from chemical bonding to waves. Not all the information is directly mathematical, but what is not connectable to mathematics stands on its own interest, and for the creative math instructor charts of the geologic ages, the electromagnetic spectrum, etc. are lesson plan triggers. Cross referencing is excellent and type easy to read!

–TND

## Q + A = K(nowledge)

**Q. How can we address the difficulties a dyslexic learner faces in learning Mathematics?**

**A. While we were unable, by press time, to find extensive specific responses to this question, we did uncover some applicable information:**

1. **Write Math processes in very small, manageable steps, have students read throught them aloud, and be sure they understand each step/process.**
2. **Flash cards can be helpful; help students express frustrations; be patient; help students block off information so they see only bits at a time and only one multiple choice answer at a time. Keep it quiet; don't overwhelm the student.**
3. **Teach students to compensate (emphasize strong skills or strategies). To get information from short term to long term memory review daily notes, do lots of repetition. Use a variety of methods, utilize all senses.**

***If you have more specific suggestions, please let us know.***

The Boston Tea Party took place on December 16 in the 18th century in the year ____.
The sum of the digits of the year is 18. The units digit is equal to the cube root of 27.
Answer: 1773

# Field Operations: Meet the Math Team

East and West (Massachusetts) meet at regular intervals when the ***ABE Math Team*** gathers. The Team, facilitated by Mary Jane Schmitt and Bill Arcand, which first convened in early 1992, is a growing group of ABE practitioners interested in the development and practice of teaching mathematics.

The mission of the ***"ABE Math Team"*** is to support practitioner development, and to identify and develop materials, methodologies, strategies and programs for instruction that encourage the learning and teaching of mathematics in a manner which is interesting and appropriate to adults of all cultures, and which equips them with the skill needed to achieve their goals. The team will serve as advisors to projects throughout the state, and in some cases, as project developers."

Among the projects undertaken by Math Team members and funded by a grant from the National Institute for Literacy (congratulations, Mary Jane, Bill and Sally Waldron), is a review of the NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS (NCTM) Curriculum and Evaluation Standards for School Mathematics. This review will be the first step in a process designed to "develop NCTM - based standards" for at least five ABE instructional environments. These new ABE standards will be implemented in the field. A recording of the process findings will be made and sample curricula/materials will be distributed throughtout the state.

While the Standards project is the main focus of the Math Team, it is not the only Team venture. Team members staffed "Make It, Take It" tables at the MCAE & NCTM conferences, helped produce an interactive TV Math show for the "Teaching the GED" series, participated in Bonnie Mullinex's ABE Math research project and in Project PALMS, "a five-year statewide project to improve the way math and sciene is taught." The Math Team is also responsible for this newsletter.

In case you're wondering who's on the ABE Math Team, a list follows (and please feel free to call any Math Team member with questions and/or suggestions about existing or new projects):

**ABE Math Team/East:**

Ester Leonelli, Community Learning Center (W) 617-349-6363
Linda Huntington, Community Learning Center (W) 617-349-6363
Carol Kolenik, United South End Settlements (W) 617-536-8610
Barbara Goodridge, Lowell Adult Education Program (W) 508-458-9007
Marilyn Moses, Brockton Adult Learning Center (W) 508-580-7475
Ken Tamarkin, SCALE (W) 617-625-6600
Shelley Bourgeois, Jackson Mann Comm. School.
Peg Fallon, Lawrence Adult Learning Center (W) 508-975-5917
Mary Jane Schmitt, Bureau of Adult Education, Mass Dept of Ed. (W) 617-770-7472
Martha Merson, ALRI (W) 617-782-8956
Lee Thomas, (W) 508-997-5411, ext. 2328
Tom MacDonald, Sherwin Cole, Haitian Multi Service Center (W) 617-436-2848

**ABE Math Team/West:**

Donna Curry, Mt. Wachusett Community College (W) 508-874-4623
Ruth Schwendeman, Quinsigamond Community College (W) 508-853-2300
John Ewing, The Literacy Project (W) 508-544-8917
Tricia Donovan, Franklin Hampshire E&T (W) 413-774-3182
Karen DeCoster, HALO Center (W) 413-532-2900
Leslie Arriola 413-256-8072
Bill Arcand, SABES Coordinator, HCC (W) 413-538-7000 Ext. 586
Debra Richards, Quinsigamond Com.Col. (W) 508-752-0797
Kathy Coleman, Worcester Adult Learning Ctr. (W) 508-799-3090
Sally Spencer, Care Center (W) 413-532-2900
Bonnie Mullinix, UMASS, (W) 413-545-0747

# The Problem Solver

A Math Newsletter for Adult Educators Vol. 1 No. 2 Spring 1993

**EDITION FOCUS: COMMUNICATION AND CONNECTION STANDARDS**

## Communicate - Connect

The Massachusetts ABE Math Team worked this winter on adapting the NCTM (National Council of Teachers of Mathematics) K-12 Curriculum and Evaluation Standards for the adult education community. Ruth Schwendeman of Quinsigamond Community College and Esther Leonelli of the Community Learning Center, the two team members responsible for writing the final drafts of these adapted Standards, have shared with The Problem Solver the initial drafts of the Communications and the Connections Standards. Final drafts of these Standards will be available this fall. These Standards are meant to provide instructors with a framework for teaching adults mathematics. As with all the Standards, they encourage innovation and student-centered instruction.

### Mathematics as Communication

Much of the mathematics adults do everyday requires some explanation or dialogue between two or more persons. This occurs in the workplace, at the grocery or clothing store, at the bank, and certainly in the homes of every adult dealing with the day-to-day demands of keeping a household financially together. Given this real world context for math usage, it is essential that the mathematics curriculum for the ABE classroom involve and include strategies for shared problem solving experiences.

Many ABE math classrooms have the combined goal of teaching math while teaching English, and learning the language of math is like learning the language of English—the learner must see it, say it, write it, hear it and talk about it before real learning takes place.

While adults often do need time and silence to practice and sharpen their performance of necessary algorithms, too easily they become obsessed with "getting the (only) right answer." This limited exchange between the learner and the answers in the back of the book makes math learning an isolated experience clearly at odds with the ways in which math is used everyday.

Curriculum planning for the ABE classroom must also address communications issues surrounding sometimes limited functional learning levels: instructions in printed material

(See Communications and Connections, page 9)

## The Editor's Angle

Ah-h, it's time to celebrate: we have endured winter and finally published the second edition of The Problem Solver. Though we received many compliments on the first edition, we strive to keep improving, and feel that the best way to do so is to include the writing and knowledge of as many math/ABE instructors as possible. So, PLEASE, if you or your students can help in anyway, contact me (Tricia Donovan) at F/HETC, One Arch Place, Greenfield, MA 01301 (413-774-3182). On behalf of all readers, thanks.

As for this edition of The Problem Solver, our focus is on two of the Curriculum and Evaluation Math Standards: Communications and Connections. These Standards (a preview of the Math Team's adaptations is in our lead article) are particularly relevant in adult education settings where students are frequently trying to learn more than one subject at a time and have a real need to familiarize themselves with the language and concepts of mathematics.

We hope our readers will become more familiar with these important Standards—Communications and Connections — and that they will find in the newsletter materials and information useful for the implementation of these Standards in their own classrooms. Above all, it is in the spirit of the Standards to enjoy Mathematics — teaching and learning it — therefore, we hope all you read here encourages you to do just that!

–TND

## *Don't Miss...*

Activity Pages ................. 7-8
Book Corner ..................... 12
Field Operations .............. 13
Intersections ..................... 14
Perspectives...................... 2
Points of Interest ............. 4
Q & A ............................... 11
State Lines ........................ 3
Student Segment ............. 10

# Perspectives

*A column of practitioner musings. Readers are invited to share their own experiences teaching or learning mathematics, or to respond to this issue's story. This months's story, by Bill Haley of Employment Connections, Inc., Chelsea, details work he is doing to create a Math tutorial software package for pre-vocational adult students. The primary focus of the software package is fractions.*

To assist adult learners to understand and to use fractions, I am developing a tutorial program that can be integrated into an ABE class. This program contains instruction and testing in fractional values recognition and differentiation, conversion, LCD, reducing/raising, borrowing, cancelling and notation.

While the tutorial is being developed on a Macintosh computer, it can be run on any MS-Dos personal computer as well as on any Apple or Mac. The tutorial authoring system being used is called "QAuth", a tool or software shell developed by Intentional Educations of Watertown, MA.

QAuth holds up to 140K of data, and features user-friendly menu/submenu creation, vocabulary review, animated graphics and feedback. QAuth has been designed to create educational products for use in Computer-Aided Instruction (CAI).

My tutorial employs various formats; text passages, fill-ins, multiple choice, etc. It also uses animated graphics to help concretize the ideas of raising fractions and cancelling. Most helpful is the feedback feature. I can create a response/explanation that automatically appears on screen when a student chooses the wrong answer(s). With that response I can clarify errors immediately, as they are made.

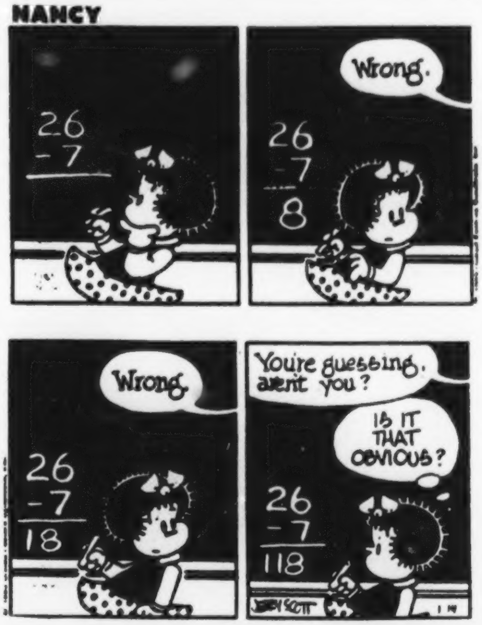
The subject matter and methods that inform the tutorial are guided by three influences. First, the aims of the tutorial are those articulated in the most recent publication of the NCTM's Standards, specifically those contents and emphases proposed for grades 5-8. Second, I assume the practicality of multiculturalism; names, ideas, idioms or special phrases address an international student user. Third, multi-integered fractions are intentionally avoided. Problems deal with halves, thirds, tenths, etc., in an attempt to convey "real-world" familiarity.

Finally, the ultimate goal is to develop for myself, and others who may be interested, a helpful computer tool to assist me in providing one-on-one instruction to leaners who need it. Hopefully, those students needing a quick review or repeated immersion in the basics of fractions can access either through the tutorial.

–Bill Haley

*Response to last month's article by Martha Merson: How do we best use a particular student's expertise to help others learn a skill? Do we have that person share how they learned to do what they do and how they do it (like Tanya in Martha's story doing tithes)? Do we supply Tanya with some manipulatives such as purchase items and money to demonstrate her method? Do we offer the student's method as one of a menu of methods and encourage students to practice with them all and evaluate which one they found most useful? WHAT DO YOU THINK, READERS?*

---



**Cottage Cheese Problem:** A member of Weight Watchers's was following a recipe that called for three-fourths of two-thirds of a cup of cottage cheese. He did not know how to multiply fractions. How did find three-fourths of two-thirds of a cup?

**Answer:** (From A.R.L.L.) He used measuring cups to find 2/3 of a cup of cottage cheese. Then he patted it into quarters and used three of the quarters. How much did he have? One-half a cup. What other methods might he have chosen?

**The Problem Solver**
F/HETC, One Arch Place, Greenfield, MA 01301
(413) 774-3182; FAX: (413) 784-1765

Editor - Tricia N. Donovan
Layout - Marie Louise Houle

# State Lines

By Mary Jane Schmitt, State Bureau of Adult Education

*One of the most important state-wide adult-related educational projects currently underway is PALMS (Partnership to Advance the Learning of Math and Science). Much exciting work on the Connections between math and science is being accomplished at various sites. The following is a report on the current status of PALMS and a glimpse into the PALMS activities at several learning centers in January and February.*

*–TND*

Just as PALMS teachers returned to their districts to spread the message and philosophy of PALMS to other K-8 teachers and their students, after the 14-week PALMS Institute, I went out to the adult learning centers to work with teachers and adult learners. So, three mornings a week I jumped in my Honda...the trunk and back seat chock full of pattern blocks, calculators, base-ten blocks, Microsoft Works, science experiments, and a variety of other resources...and headed out to spend the day at one of the demonstration sites.

Now, I expected to enjoy this "post-institute" phase of PALMS where the rubber meets the road, but I am absolutely floored by the eagerness with which the ABE (adult basic ed/literacy), GED (high school equivalency) and ESL (English as a Second Language) teachers and students are embracing "hands-on" approaches to learning math and science.

## Learning Center Snapshots

### The Worcester Adult Learning Center

Cathy Coleman's class meets every morning for three hours, Monday through Friday. Her students are all women who are working on their reading, writing, math and English skills. Their reading and math skills range from a 2-5th grade level. The program is funded by DPW and, even though attendance is required , it's obvious that the women are there to learn and enjoy being in class.

At our first meeting, Cathy explained that her interest right now is to explore some science with her students. She has done some lessons on health issues, like AIDS, and is hungry for resources that are high-interest and easy reading level. She's interested in "hand-on" science, but wants to know how to start.

PALMS NETWORK TIME! We picked up the phone, called Duke Dawson at the New England Science Center, and trekked over to check out the place. Duke gave us a tour of the center, invited Cathy and her students to visit, and told Cathy that after she surveyed her class to see what area of science they were interested in, he'd be happy to help her with some lessons. Right now Cathy's students are compiling the results of their own surveys, integrating math and science skills right from the beginning, another one of Cathy's goals.

The women are just beginning to work with fractions this month. When I arrived with buckets of Pattern Blocks, they were skeptical. One woman said, "Kindergarten." Luckily, the Boston Globe had just featured an article on "Adults Relearn Math" with a picture of a teacher using pattern blocks. We started the class with a discussion of how people felt about math, and then I read some parts of the article to them. All agreed to enter into the experiment of exploring some harder math with these blocks. After an hour, the women began to appreciate how the these little colored pieces could help give meaning to algebraic and arithmetic expressions (Y= R + B + G) and 1 = 1/2 + 1/3 + 1/6).

### The Haitian Multi Service Center

As soon as you walk through the door of the "Old St. Leo's Rectory" in the Franklin Field section of Dorchester, you know it's a special place. This community-based organization is run by and for refugees and immigrants from Haiti. Everyone speaks Haitian Kreyol, and some people speak English. The teachers and adult learners have proven what we have suspected: the PALMS philosophy translates to all ages and to speakers of a 11 languages!

The Haitian Multi Service Center (HMSC) has built a fine education program which centers around three

(See State Lines, page 5)

## Points of Interest...

**The Boston College Mathematics Institute.** **July 5-9**, 8:30-3:30. A math renewal course for secondary teachers (we assume adult educators are welcome) to discuss course content change in light ofthe NCTM Curriculm Standards. Three graduate credits. Contact Stanley J. Bezuszka, S.J., B.C. Mathematics Institute (617) 552-3775.

**ATMNE (Association of Teachers of Mathematics in New England) Annual Meeting,** November 4-6, Springfield. Contact Lyn Heady, White Brook Middle School, Easthampton, (413) 527-6000.

**Massachusetts Mathematics Initiative (MMI)** is an alliance of leaders from the eduation, public policy and corporate sectors who seek state-wide improvement in mathematics education for all students at all levels. MMI produces and updates on an annual basis, the Massachusetts Mathematics Resource Data Base and publishes in the spring and fall, the Massachusetts Mathematics Initiative Newsletter. If you are interested in these publications or knowing more about MMI, contact MMI c/o Bill Masalski, School of Education, University of Massachusetts, (413) 545-1577.

**The Adult Literacy Resource Institute (A.L.R.I.)** operates a literacy library at 989 Commonwealth Ave., Boston, MA 02215. The Library is open Wed. and Thurs., 9:30-4:30 p.m. and Tuesdays 5-7 p.m., though books may be returned to the front office anytime Mon.-Fri., 9-5. A.L.R.I. also offers many workshops and mini courses. The contact person is Steve Reuys, 617-782-8956.

**Math Solution**, a training for teachers based upon Marily Burns' work is coming to Massachusetts in June.

**NCTM Regional Conference**, New York, New York, May 27-29

**Uncle Sam's Budget Balancer**, a computer software program that lets anyone with an IBM computer balance the U.S. budget is available for $10 from Banner Blue Software, 39500 Stevenson Pl., Suite 204, Fremont, CA 94539; (510) 794-6850; fax (510) 794-9152

**MathWest**, a group of math teachers of all ages of learners meets four times a year to hear a speaker and discuss class issues/materials and related projects. If you are interested in being on their mailing list call Lyn Heady, (413) 256-8316.

**Adult Education Conference:** A conference combining 40 adult education math reform instructors and 40 adult education policy makers (funding agencies, testing services, etc.) is slated for early January, 1994 to impart the principles for a vision of adult math education and create some "next steps" for a plan of action (perhaps calculator use on the G.E.D. test, etc.). The task force for this national conference which is funded by NCTM (National Council of Teachers of Mathematics) and NIL (National Institute for Literacy) is being chaired by Mary Jane Schmitt, co-director of the Mass. ABE Math Team. Ed.

### Personnel Changes

–**Donna Curry** is no longer affiliated with Mount Wachusett Community College.

–**Lee Thomas** can now be contacted at the New Bedford Adult Learning Center, 80 Rivet Street, New Bedford, MA 02740 (508) 997-4511 X 2328.

–**Lindy Whiton** has been hired to assist Bill Arcand in the SABES office, Holyoke Community College. Lindy will be coordinating meetings, workshops, etc. for the Western Mass. adult education community and brings years of valuable experience in the literacy community and education field to her position.

### Summer Teaching Positions Available

The Division of Continuing Education at Holyoke Community College is looking for a math instructor for its Kids at College program this summer for July 2 through the 23. The program runs two weeks in the morning with Math classes begining at 8:15 and ending at 10:15. The program is designed for accelerated and advanced students or students who just enjoy school. The math class itself is designed to take the anxiety, difficulty out of math and give it some meaning. In the past, the class has consisted of math games, puzzles, brain teasers, money matters, logic, and geometry. Ken White is looking for an enthusiastic, fun math instrutor that has had experience teaching elementary and middle school children. Class sizes will be approximately 15 to 20 students. Stipends - $600. Interested teachers can contact Ken White at Holyoke Community College at 538-7000, Ext 324.

---

**Have any news for Points of Interest?** Our next issue will be out in the fall, so any workshops or other scheduled event information should be for the Oct. - Jan. period. You can contact The Problem Solver through Math Net, ABE (FHGTC) or contact Tricia Donovan, c/o F/HETC, One Arch Place, Greenfield, MA 01341 (413) 774-3182; FAX: (413) 784-1765.

# State Lines

(Continued from page 3)

areas: native language literacy, for immigrants who are learning to read and write in their own language; ESL for folks who need survival skills in spoken and written English; and EDP or the Boston External Diploma Program , an alternate way to get the High School credential. Very little math, and less science, had been part of the curriculum until recently when the staff responded to requests by students for math classes. So, this year, as members of the PALMS Project, four teachers at the center have joined together to build a math component.

There are four math level classes at HMSC. Marlene Milicent teaches the very basic class. Her students, who are just beginning to read and write in their own native Kreyol, also learn the basics of reading and writing numbers. Jean Louis Daniel's class, also taught in Kreyol, is studying fractions, many of them for the first time. He uses both hands-on methods and traditional French algorithms in the class. This class has a wonderful atmosphere of mutual support. Jean Louis participated in the Organizational Change Team meetings and is interested in the family math piece of PALMS.

Tom McDonald, who is also on the ABE Math Team Standards Project, teaches his class in English. His students, who are part of a transition program preparing for the community college, are engaged in solving non-traditional word problems. Tom is interested in having his students expand their notions of doing math beyond isolated computation. So, he encourages cooperative problem solving and sharing of strategies.

Sherwin Cole's class is studying beginning algebra and very open to the manipulatives (two color chips for integers; base-ten unit blocks for building models of squaring and cubing numbers.) This way of looking at algebra is new for Sherwin, too. The students in all these classes are there on a voluntary basis. At the last center-wide meeting, more students were clamoring to get into the math classes. So PALMS has a waiting list!

Tom has built in a very lively computer component and both students and teachers are using the PALMS' Microsoft works. We still need to get them on Internet.

Twice a month, I visit the classes, and may co-teach in Sherwin's and Tom's because they're in English. In Jean Louis' and Marlene's, I am an observer. All of us meet in the afternoon to talk about a variety of topics, like what happened in class, fractions, income tax, math scope and sequence, and computers. This is a time when the five of us share techniques and materials.

**Quinsigamond Community College**

Deborah Richard's two classes meet at St. Peter's Church in Worcester every morning. Deb teaches two levels: ABE and GED. The men and women are mostly native born Worcesterites, but there are some Latinos.

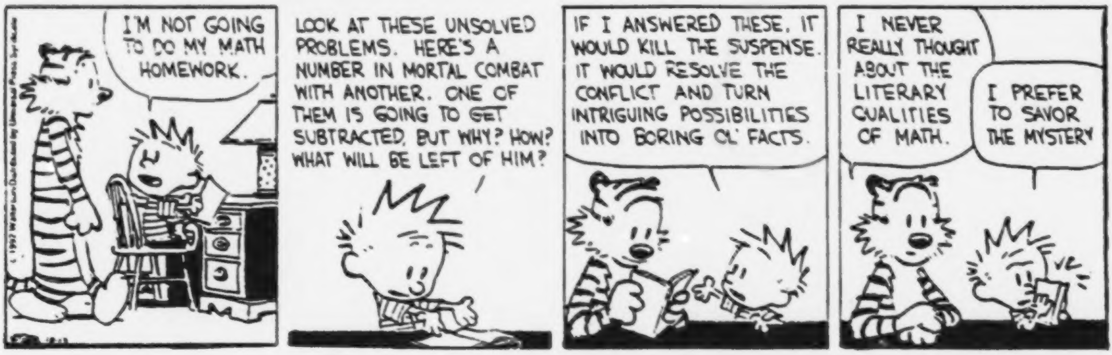
The students are excited to be part of the PALMS' project and really have gotten into the hands-on way of learning math. All ready, folks are starting to comment on how this way really makes you see the math. The higher level class, studying for the GED, has explored angle and triangle relationships with pattern blocks. We can see their confidence grow in this area.

The ABE class is becoming more confident in their workings with fractions and percent. Deborah challenges her students by having them write their own word problems and then comment and critique each other. She pretty much steers clear of rote learning. So there's a lot of thinking and grappling with real math issues.

Deborah is also a member of the ABE Math Team Standards' Project. She is very interested in maximizing use of manipulative this year in class. Betsy Zweigg, the director of the education program, is very active in building a family literacy component and is eager to build upon the PALMS Project.

(See State Lines next page)

■ CALVIN & HOBBES / Bill Watterson


I'M NOT GOING TO DO MY MATH HOMEWORK.
LOOK AT THESE UNSOLVED PROBLEMS. HERE'S A NUMBER IN MORTAL COMBAT WITH ANOTHER. ONE OF THEM IS GOING TO GET SUBTRACTED. BUT WHY? HOW? WHAT WILL BE LEFT OF HIM?
IF I ANSWERED THESE, IT WOULD KILL THE SUSPENSE. IT WOULD RESOLVE THE CONFLICT AND TURN INTRIGUING POSSIBILITIES INTO BORING OL' FACTS.
I NEVER REALLY THOUGHT ABOUT THE LITERARY QUALITIES OF MATH.
I PREFER TO SAVOR THE MYSTERY.

# State Lines

(Continued from page 5)

**Holyoke Adult Learning Opportunities Center (HALO)**

Karen Decoster runs her pre-GED/GED class as a democracy. Their self-written constitution hangs on the wall. This gives you just a hint of how Karen implements "hands-on" learning. The students need to study U.S. government for the GED, so why not actually experience it? Now, Karen loves history and literature, and her students are very turned on by Hamlet. At the beginning of the year, Karen thought she'd give the PALMS Project a try, but she really didn't much care about math and science. Hands-off you might say. Well, the worm has turned, and Karen and her students now are outspoken proponents of the PALMS Project.

Karen is now going full speed ahead integrating math within the science. I am in awe of her creativity and courage as she tackles new topics.

While I pretty much brought in ideas for exploring geometry, Karen and I both decided to explore science together. Balloons, batteries, wires and bulbs have replaced the typical GED workbooks. People are excited and share their understandings and questions freely. Mary and Donna have been real supportive, and came by one day to meet the students; Ed was there for the intro to electricity and invited the students to come to the labs at Mt. Holyoke; Karen attends the change team meeting when she can. And all this in the little store-front learning center in downtown Holyoke!

**The New Bedford Adult Learning Center**

Lee Thomas' pre-GED class meets daily on the third floor of a New Bedford elementary school. The make-shift space is carved out of an auditorium, but Lee's class has a welcoming and comfortable atmosphere. The men and women, mostly Portuguese, sit at tables arranged in a circle and interact comfortably with one another. Lee is a very organized and creative teacher. While we use the time after class to brainstorm ideas and share materials and techniques, I'm an observer/aide during class. And what a class!

Lee uses Tuesdays to do an extended integrated math or science project that is built on an interest of the students. During a project on nutrition, there was a lot of discussion and collection and analysis of data. Students brought in packaged foods and compared and analyzed contents. Even though some students hadn't formally studied percent or formulas, everyone was actively calculating % of fat content in the foods. Each student has a calculator and Lee weaves a calculator activity into each lesson. (Please note that this natural use of calculators is generally discouraged or ignored in typical adult ed classes.)

On the day they were studying waste disposal and recycling, Lee's class formed a human circle graph. I've encouraged her to take pictures of and audio-tape the classes. She will document some of her lessons for the ABE Math Standards Project book, but I think she should share her lessons with other teachers.

**State Bureau Moves:** The State Bureau of Adult Education is moving from Quincy to Malden in May. Watch for new phone numbers.

**24 Coins Problem:** You have 24 coins whose amounts totalled equal $1. What combination of coins do you have?

(Eight solutions have been noted so far. If you find more, let us know. Ed.)

**Change Problem:** What's the maximum amount of change (in coin) that you can have and still not make change for a dollar?

Answer: $1.19, 3 quarters, 4 dimes and 4 pennies

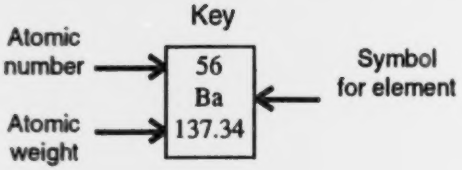
**Questioner:** You are in a room with 2 buckets. A blue bucket filled with water and a red bucket that is empty. A fire breaks out in the room. What will you do?

**Mathematician:** That is easy. Get the blue bucket and use the water to put out the fire.

**Questioner:** Good. Now consider a room with 2 buckets. This time the blue bucket is empty and the red one has water. A fire starts. What will you do.

**Mathematician:** Easy also: Take the water from the red bucket and dump it in the blue one. This reduces the problem to the earlier one.

# Periodic Table of the Elements



Transition Elements

| IA | IIA | IIIB | IVB | VB | VIB | VIIB | VIII | | | IB | IIB | IIIA | IVA | VA | VIA | VIIA | Zero |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>H<br>1.008 | | | | | | | | | | | | | | | | 1<br>H<br>1.008 | 2<br>He<br>4.003 |
| 3<br>Li<br>6.940 | 4<br>Be<br>9.013 | | | | | | | | | | | 5<br>B<br>10.82 | 6<br>C<br>12.011 | 7<br>N<br>14.008 | 8<br>O<br>16.000 | 9<br>F<br>19.00 | 10<br>Ne<br>20.183 |
| 11<br>Na<br>22.991 | 12<br>Mg<br>24.32 | | | | | | | | | | | 13<br>Al<br>26.98 | 14<br>Si<br>28.09 | 15<br>P<br>30.975 | 16<br>S<br>32.066 | 17<br>Cl<br>35.457 | 18<br>Ar<br>39.944 |
| 19<br>K<br>39.100 | 20<br>Ca<br>40.08 | 21<br>Sc<br>44.96 | 22<br>Ti<br>47.90 | 23<br>V<br>50.95 | 24<br>Cr<br>52.01 | 25<br>Mn<br>54.94 | 26<br>Fe<br>55.85 | 27<br>Co<br>58.94 | 28<br>Ni<br>58.71 | 29<br>Cu<br>63.54 | 30<br>Zn<br>65.38 | 31<br>Ga<br>69.72 | 32<br>Ge<br>72.60 | 33<br>As<br>74.91 | 34<br>Se<br>78.96 | 35<br>Br<br>79.916 | 36<br>Kr<br>83.80 |
| 37<br>Rb<br>85.48 | 38<br>Sr<br>87.63 | 39<br>Y<br>88.92 | 40<br>Zr<br>91.22 | 41<br>Nb<br>92.91 | 42<br>Mo<br>95.95 | 43<br>Tc | 44<br>Ru<br>101.1 | 45<br>Rh<br>102.91 | 46<br>Pd<br>106.4 | 47<br>Ag<br>107.88 | 48<br>Cd<br>112.41 | 49<br>In<br>114.82 | 50<br>Sn<br>118.70 | 51<br>Sb<br>121.76 | 52<br>Te<br>127.61 | 53<br>I<br>126.91 | 54<br>Xe<br>131.30 |
| 55<br>Cs<br>132.91 | 56<br>Ba<br>137.36 | 57<br>*La<br>138.92 | 72<br>Hf<br>178.50 | 73<br>Ta<br>180.95 | 74<br>W<br>183.86 | 75<br>Re<br>186.22 | 76<br>Os<br>190.2 | 77<br>Ir<br>192.2 | 78<br>Pt<br>195.09 | 79<br>Au<br>197.0 | 80<br>Hg<br>200.61 | 81<br>Tl<br>204.39 | 82<br>Pb<br>207.21 | 83<br>Bi<br>209.00 | 84<br>Po | 85<br>At | 86<br>Rn |
| 87<br>Fr | 88<br>Ra | 89<br>‡Ac | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LANTHANIDE SERIES | 58<br>Ce<br>140.13 | 59<br>Pr<br>140.92 | 60<br>Nd<br>144.27 | 61<br>Pm | 62<br>Sm<br>150.35 | 63<br>Eu<br>152.0 | 64<br>Gd<br>157.26 | 65<br>Tb<br>158.93 | 66<br>Dy<br>162.51 | 67<br>Ho<br>164.94 | 68<br>Er<br>167.27 | 69<br>Tm<br>168.94 | 70<br>Yb<br>173.04 | 71<br>Lu<br>174.99 |
| ‡ACTINIDE SERIES | 90<br>Th<br>232.05 | 91<br>Pa | 92<br>U<br>238.07 | 93<br>Np | 94<br>Pu | 95<br>Am | 96<br>Cm | 97<br>Bk | 98<br>Cf | 99<br>Es | 100<br>Fm | 101<br>Md | 102<br>No | 103<br>Lw |

**Activities to go with this table are on the next page.**

# Guess that Atomic Weight!

Karen DeCoster, HALO Center, Holyoke

The periodical chart is teeming with mathematical connections. Here's just one...... You will need: 2 large sheets of paper black and red marker multiple copies of periodical chart.

Have students scan the periodical charts for elements they're familiar with - gold, oxygen, iodine, etc. Use one large sheet of paper as a brainstorming list for recording at least ten elements they know. Put the periodical charts away for later use.

Of the first two elements on the periodical chart, most students recognize helium as "the balloon gas" more than they recognize hydrogen. Moreover, it will probably be one of the elements on their brainstorming list. So begin by circling helium while you introduce its atomic weight of 4 amu's (atomic mass units).

Ask students to estimate, or hypothesize, about the weights of the other elements they've listed, using helium (4 amu's) as the reference point. Circle five elements (from their list) that they'd like to start with. Use the other sheet of paper to make a color coded chart of these estimates, but do it in two separate rounds as follows:

**Round One**

| | Element | Estimate | Actual Atomic Mass |
|---|---|---|---|
| Round One: | gold | | |
| | oxygen | | |
| | neon | | |
| | copper | | |
| | aluminum | | |
| | | | |
| | | | |
| Round Two: (later) | | | |
| | | | |
| | | | |

One element at a time, get a sampling of students' estimates all based on He being 4 amu's. Record the average, or two to three estimates, in the estimate column using the red marker. Let discussions and debates develop - they're marvelous!

After the estimates are recorded, ask students to take out their charts again and find the actual weights. USE THE BLACK MARKER TO RECORD the actual weights in the last column. Ask students to compare and discuss the accuracy of their estimates.

**Round Two**

Now that the students are more aware of common elements and their relative weights, go to round two - but switch marker colors. Use *black* for these *new estimates* and *red* for their *actual weights*. Again, list five or more different elements from the brainstorming list and proceed as with round one.

Through a color comparison of round one and two, discuss how estimates may have improved in round two. Several other math/science connections should spill out of this activity. Let it grow!

Sample Decimal connection: Periodical Chart Hunt: Which pairs of elements break the sequence of atomic weight from left to right?

Science connection: Can you find out why?

## Communication and Connections

(Continued from page 1)

should be at a reading level which makes the work accessible to a wide range of learners, and attention should be paid to mathematics terminology which often have common English meanings that differ from their mathematical definitions.

In the ABE classroom, curriculum design must include approaches to teaching mathematics as communications which allow the learner to:

- develop appropriate reading, writing, listening and speaking skills necessary for communicating mathematically in a variety of settings;
- discuss, reflect and clarify their own thinking about mathematical outcomes, and make convincing arguments and decisions based on these experiences;
- define everyday, work-related or test-related mathematical situations using concrete, pictorial, graphical or algebraic methods;
- appreciate the value of mathematical language and notation in relation to mathematical ideas.

–Ruth Schwendeman

### Mathematical Connections

The Connections Standard recognizes that adult learners need to relate math and mathematical thinking to all academic fields as experienced in the real world and work-related settings. The Standard also encourages teachers to investigate the inter-connections between and among math subjects and to avoid presenting mathematics as a linear progressions of topics. Rather than teaching isolated skill, adult educators can use a holistic teaching approach, connecting math to students' daily lives to create more meaningful math programs. Math is more than computation and ABE teaching must move beyond teaching computation in isolation or out of context.

ABE math instruction, as well as math for ESL students, should integrate teaching language skills (listening, reading, writing, and speaking) with teaching math content skills. The ABE teacher must be familiar with the students' educational, cultural, and language background to connect with students' thinking and be flexible enough to build on the different ways which adults learned math as children.

Making mathematical connections facilitates a spiral approach in teaching adults, allowing the teacher to reach the broad range of academic and literacy skills in the ABE classroom.

For the adult learner it is important to be aware that mathematics is more than a set of isolated solutions to a set of isolated topics. The ABE curriculum should include opportunities for learners to see how mathematical ideas are related and connected within the area of mathematics. For the low-level learner it means linking conceptual and procedural knowledge. Connections should be explored (using concrete materials and appropriate technology), discussed (developing language skills), and generalized. Making connections thus aids learners as they move from concrete thinking and problem solving to more formal abstract concepts. It also broadens their perspective to view mathematics as an integrated whole.

With respect to workplace education, the learner must be able to transfer the mathematical skills, insights, and problem solving strategies used in the classroom setting to job situations. The learner's ability to make mathematical connections makes the learner a more flexible, efficient, and productive worker.

For all adults math learning should be relevant and connected to real life situations. Learning the math necessary to pass a high school equivalency or adult diploma competency should not be enough. When mathematical ideas are connected to every day experiences and life skills, learners become aware of the usefulness of mathematics beyond the classroom, the importance of math in all career choices, and as a useful tool applicable to the real world.

In the ABE classroom, curriculum design must include approaches to making mathematical connections which allow the learner to:

- SEE MATHEMATICS AS AN INTEGRATED WHOLE that is connected to past learning, the real world and adult life skills, and work-related settings;
- EXPLORE PROBLEMS AND DESCRIBE RESULTS using a variety of mathematical models or representations including graphs, concrete, verbal, and algebraic models or representations;
- APPLY MATHEMATICAL THINKING AND MODELING TO SOLVE PROBLEMS THAT ARISE IN OTHER DISCIPLINES, real world, and all work-related settings.

(Items in caps are taken from the NCTM Standards for Curriculum and Evaluation, 1989.)

–Esther D. Leonelli

# Student Segment

*Contributors for this issue's Student Segment come from several learning sites and situations. One common thread in their work was the "Take Five" Poem. The format for these poems, introduced by Karen DeCoster of the HALO Center in Holyoke, is to have students start with the word Math (or a statement about math) on the first line; the second line is two adjectives; the third line is three verbs, and the fourth line is a statement about math with the poem ending on a fifth line that just says, "Math".*

**"Take Fives" from *The Skills Development Program at Digital/Westminster*, Donna Curry Instructor**

Math
Challenging, positive
Thinking, writing, talking
I really enjoy working with math.
Math

Math
Education, confidence
Figures, mental, answers
Math helps in building a better future for myself.
Math

Math
Sweaty palms, dry throat
Subtract, divide, addition
I find math challenging.
Math

Math
Love, challenge
Hiding, finding, solving
Math is like a game of hide and seek.
Math

**"Take Fives" and a Poem from Brenda Ewing's *G.E.D. Class, F/HETC, Athol***

Math
Concrete and compliant
Creating, cultivating, contemporaneous
Chaotic, catastrophic, without caliber the Earth
without Mathematics.
Math

Math
Parallel, horizontal
Measuring, - adding - finguring it out
Geometry can tell you what shapes, sizes and
angles are about.
Math.

Math
Significant, necessary
Hardworking, faithful, obedient, precise
When working on math, be wise, check it twice.
Math

– Beverly Chamberlain

### Numbers Big and Bold

Children counting, Elderly adding, while
Uncle Sam's subtracting
Sum remain with bulging pockets, while sum
need to borrow and are left with only sorrow.

–Carrie Coffin

**The following problem and math thought are from the *F/HETC Greenfield Class* after working on ratios and proportions:**

"Math is like sex
for a couple who've been married
97 years —
most of the time
'Ya just don't get it"'.

–MKR

### Take Me Out To The Ball Game

Two fathers and two sons go to a ball game. They buy three hot dogs and three cokes. Everyone gets a hot dog and a coke. How is this possible?

–Al Fisher

Answer: The party includes a grandfather, father & son

*Can you construct one or more word problems (ABE or GED) from this news item?*

### HeadLine: Now This Is Overtime Pay

Story: Denver & Rio Grande Western Railroad had to pay $17,575 in overtime to 56 employees who were stranded for a week on a train in 22 foot high snowdrifts in the mountains near the Colorado border. The employees had plenty of food, a warm place to sleep, and water on hand. The overtime started after the first 8 hours.

## Q + A = K(nowledge)

Q. What would be a good "starter kit" for introducing the use of manipulatives in the classroom?

A. With the great variety of materials that are available from so many different suppliers, it is difficult to make a standard choice of manipulatives. Any product that promotes and encourages cooperative learning, group inter-action and development of problem-solving skills is suitable and satisfactory.

Pattern blocks, Cuisenaire rods and a fraction kit would certainly serve the purpose of a starter kit. However, "teacher-made" materials can be just as effective and the challenge for any teacher is to find that works best for the student.

Readers are encouraged to share ideas about activities with manipulatives that have provided an exciting learning experience for students.

***Note:*** *Some additional information has come to our attention regarding last issue's question, "How can we address the difficulties a dyslexic learner faces in learning mathematics?"*

From the "Chalk Talk" education column in The Boston Globe comes this report: "Dyslexia often affects the acquisition of mathematical language, both symbolic and literal, and the understanding of mathematical ideas. The relationship between dyslexia and learning difficulties in mathematics seems to be strong; approximately 40 percent of dyslexic people are discalculic as well. One of the best ways for an adult to learn mathematics is to study sound methods for teaching mathematics to children. Good courses on teaching mathematics use hands-on materials to illuminate mathematical ideas. Often students in these courses suddenly say out loud, 'Oh, so that's why it works'. You may wish to get in touch with Mahesh Sharma, director of the Center for Teaching and Learning of Mathematics, 47-A River St. Wellesley, MA 02181 or (617) 235-7200.

### "Numbers on a credit card..."

Did You Ever Wonder?

Did you ever wonder why there are so many numbers on a credit card? Well we did! There are actually thirteen numbers in a credit card. The reason is because with thirteen numbers, there ten trillion possible combinations. But for a credit card such as Visa, there are actually only 65 million actual Visa accounts. Thirteen numbers was selected in order to avoid the possibility of a clerk writing down the wrong number and you ending up with someone else's charges. According to the Visa people, with thirteen digits the possibility of an error such as that is 65 million to 10 trillion. With only ten digits the odds of an error occurring are 1 in 150,000.

**Born:** August 28, 1867, Maxine Bocher, prolific writer on differential equations.

**Published:** July 11, 1677, Liebniz's work on the fundamental theorems of calculus.

**Born:** August 23, 1829, Moritz Cantor, leading math historian.

+ - * / = π + - * / = π + - * / = π + - * / = π + -

**Problem:**

"I raise chickens and pigs," said the farmer, "and, like it or not, I also raise flies, a thousand creatures in all, and there are exactly ten flies to annoy every leg of every domestic animal." How many chickens, pigs, and flies does the farmer have?

**Answer:**
32 chickens, 8 pigs and 960 flies

# The Book Corner

**Historical Connections in Mathematics** *Resources for Using History of Mathematics in the Classroom*, by Wilbert Reimer, Luetta Reimer
Published by: AIMS Educational Foundation Box 8120 Fresno, CA 93747-8120.

Mathematics is a field of ongoing discoveries made by real people, and *Historical Connections* introduces us to 10 of those characters. In a readable format, the authors present information on the life, contributions, quotations and applications of a diverse group of famous mathematicians. Best of all, each chapter includes five or six interesting math activities suitable for classroom use.

The list of characters explored in this unique volume range from Pythagoras (560-480 B.C.) to Blaise Pascal (16-23-1662) to Carl Gauss (1777-1855). Regretfully, in reflection of the development of mathematics, there is but one woman represented in the book, Sophie Germaine. The historical background of these mathematicians is interesting and informative and would make a great introduction to more general historical information.

But as a teacher, I found the most useful part of *Historical Connections* to be the worksheets of intriguing problems that accompanied the biographies. The activities range from explanation and practice of the Russian Peasant Method of Multiplying to a skit to read on "the Short Giant," (Isaac Newton).

This is an excellent resource for interesting problems, and it's great fun to read about the mystical practices of Pythagoras, etc. Every page seems to grab your attention and hold it. Additionally advantageous features include reprint permission (200 copies per class), a comprehensive resource list and a "suggestions and solutions" section.

### Newly Available...

*Teamwork: The Quality Message*, by Donna Curry. (See Field Operations. Available FREE from Bureau of Adult Ed.)

*Workplace Education Education: Voices from the Field*, a 50-page report on five themes central to the designing and operating of successful workplace literacy projects. Free from the Clearinghouse Division of Adult Education and Literacy, U.S. Department of Education, Washington, DC 20202-7240. Include a self-addressed envelope.

–TND

### For Low-Level Learners...

The following is a list of books, compiled by Esther Leonelli, that are suitable for low-level learners. We lack space to review each of the volumes, but have included the bullets Esther forwarded.

- Contemporary's *Number Sense* Series (10 books) for computation...
- Contemporary's Estimation Series: called *Real Numbers* includes Estimation 1 (whole numbers); Estimation 2 (fractions & percents); Algebra Basics, Measurement; Geometry Basics (6 books)
- Anita Harnedek, *Introductory Word Problems* (Critical Thinking Press) (over 50 problems...most one or two lines...and only uses two numbers throughout the book — 10 and 40!!)
- check out *Family Math* for some activities...
- Sandra Cohen, *Figure It Out* (Books 2 and/or 3), Curriculum Associates (1-800-225-0248)
- for low-level math skills as well...*Attack Math* series...goes through addition, subtraction, multiplication, division, from single-figure facts to carrying and two-digit multiplication, etc....Very little text and lots of graphics...
- Key Curriculum Series...Fractions, Decimals, Percents, for example has lots of picture/graphic problems, figuring sales tax, discounts...
- check out Critical Thinking Press...Visual Thinking skills books ??? (Yellow cover...will get more info if you want it...)
- Also, have you seen the Australian numeracy material?...I have a set of their curriculum if you want a copy...good hands-on stuff...

**Fill 'Er Up**

You have an 8 gallon jug full of water and both a 3-gallon and and a five-gallon jug that are empty. Without using any other containers, how can you divide the water into two equal parts?

Answer:
First line up your jugs in order: 8-gal, 5-gal, 3-gal
Follow this sequence in pouring:
8-0-0; 3-5-0; 3-2-3; 6-2-0; 6-0-2,
1-5-2; 1-4-3; 4-4-0. You did it!
Other solutions possible.

# Field Operations: ABE Math Team Proposed Projects

*Talk is cheap. We can discuss till retirement the benefits of implementing new Standards for Curriculum and Evaluation, but the questions remain: How can we put these Standards to work in adult education classrooms, and what happens when we try to do so? In an effort to explore various means (not to be confused with the mathematical term) of implementing math Standards, the ABE Math Team has undertaken individual research projects designed to address the above questions. Listed below is a list of the researchers and their project questions. Perhaps one or more of the questions piques your interest or relates to your own classroom practices. If so, please contact the researcher, they'd love to hear from you.*

| NAME | RESEARCH QUESTION |
|---|---|
| Leslie Arriola | What are ways that help students make the transition from passive to active learners? What is the effect on my co-teacher? |
| Shelley Bourgeois | Will learning about statistics and probability enable my students to view their world more critically and encourage them to ask more questions? |
| Cathy Coleman | How do I use student research to teach problem-solving? |
| Donna Curry | Do students gain a greater insight into and a better understanding of math concepts when they write about what they are learning? |
| Karen Decoster | What happens when I teach science with a mathematical connection? |
| Tricia Donovan | What happens when students create their own math word problems? |
| Peg Fallon | Why do my students' misunderstand the correlation between fractions, decimals and percents. |
| Barbara Goodridge | What will happen if I break my math class into teams who will regularly attempt math activities and problem-solving together? |
| Linda Huntington | How do I help students move from the concrete and manipulative understanding of fractions to real applications? |
| Esther Leonelli | What happens when students make the transition from doing percents concretely (e.g. with cuisenaire rods) to real life problem solving (e.g. taxes)? How do I assess learning? |
| Tom Macdonald | How can I encourage my students to appreciate and explore the non-computational aspect of math? |
| Martha Merson | What is the dynamic for teaching and learning fractions in a class where some ESL speakers have had instruction in their own languge and some no formal intro to fractions? |
| Marilyn Moses | What would happen if 30 - 45 minutes of each class is spent solving non-traditional problems (games, open-ended) without the use of paper and pencil? Learners may use manipulatives, calculators, or mental math. |
| Bonnie Millinix | What are some of the data from the RABEM Project? |
| Debra Richards | Can teachers and students overcome their fear of (resistance to) manipulatives? |
| Mary Jane Schmitt | What would happen if 20 ABE teachers got together to rethink and reshape the teaching and learning of math? |
| Sally Spencer | Can we develop effective alternative instruments for assessment? |
| Judy Sulzbach | Will learning and using linear metric system units give workers another means of discovering and communicating math in the workplace? |
| Kenny Tamarkin with Susan Barnard | What will happen if we add an open-ended question to with the existing ADP Math Assessment? |
| Lee Thomas | What would happen if once a week I ran a math class where: 1. Math skills are non-sequentially taught; 2. The lessons incorporate calculators and manipulatives; 3. The lessons come from student questions and concerns; 4. Assessment is done by group discussion? |

## New Book Published:

Donna Curry, a workplace educator, recently published her book, ***Teamwork: The Quality Message***. The book is divided into three sections: Team Building, Team Tools and an Introduction to Statistics (very simple, according to Donna). This book will be available FREE from the Bureau of Adult Education after May 17. The subject matter is appropriate for all adult educators. **Congratulations, Donna!**

## Intersections

**Possible Classroom-Standards**

Have students compile a dictionary of terms and symbols they use each math class. The information can be recorded and even typed for everyone as a group project or done solely on an individual basis.

Each time an historical date is mentioned in class, have students figure out how old they would be if born that year.

Encourage students to repeat verbally what they did mathematically, either to a partner, small group or whole class.

Use a learning journal in which students explain what they learned and how they now approach problems. Students can also keep track of math appearances in their day-to-day lives here.

Use newspaper articles to discuss current events and have students consider the numbers used therein in various ways. For instance, Cairo, Egypt has an overpopulation problem — 75,000 people per square mile. How many people would live in your town if it had a similar population density?

In pairs, have one student solve a problem and then have the other partner try to explain what was done.

Thank you, Math Team West, for some of these suggestions.

–TND

The Problem Solver
Tricia N. Donovan
F/HETC
One Arch Place
Greenfield, MA 01301

# The Problem Solver

A Math Newsletter for Adult Educators Vol. 1 No. 3 Fall 1993

EDITION FOCUS:
PROBLEM SOLVING:
THE STANDARD

## Problem Solving Doorway to Mathematics

*While still working on the final draft of proposed ABE Math Standards, the Mass. ABE Math Team has offered to let the Problem Solver share with its readers this nearly complete draft of the Problem Solving standard. Due to space con-siderations, the classroom vignette that prefaces the standard has been deleted. Hopefully, this omission will only increase anticipation for the completed standards, due out in January.*

**Standard 1: Problem Solving**

In adult basic education, the development of problem solving abilities must foster the growth of self-esteem, confidence, and essential critical thinking and communication skills. It is important that math instruction for the adult basic education learner provide for successful experiences in problem solving: a lifetime of negative experience or bad memories with the educational process can produce a major lack of self-esteem. This lack prevents the learner from critically attempting important risk-taking involved in thinking and communicating about math. Mathematical problem solving for the adult learner must reflect the fast-paced, technological world in which he lives. Such problem solving must also parallel another important facet of our world: our capacity for humor and fun. Real-life daily tasks do not only require computation skills, hence computation-only teaching is not enough. Instructional strategies must include methodologies which are framed by the broad empirical and cultural knowledge base of each learner. And individuals come to basic math classrooms with a wealth of non-standard problem solving strategies which must be recognized and given credibility. At all turns, the goal-centered nature of the adult mathematics learner must be acknowledged and accommodated: when the adult basic education learner cannot see his math experience as moving him closer to his objectives, the risk of failure is high.

In the adult basic education classroom, curriculum design must include approaches which allow the learner to:

- *explore and employ multiple strategies for solving problems;*
- *determine, collect, and analyze appropriate data with respect to the original problem or in new problem-solving situations;*
- *have access to and the ability to use appropriate problem solving tools including the use of calculator, computers, and measurement instruments;*
- *generalize problem-solving strategies to a wide range of adult-oriented, real-world situations.*

## The Editor's Angle

As we gear into the season, teaching our students and learning from them, it becomes apparent that we all have problems, and many of those problems have mathematical aspects to them. Because problem solving, from determining checkbook balances to fuel ratios for rocket ships, lies at the core of mathematics, we are devoting this third issue of The Problem Solver to that topic. We hope to share some contemporary perspectives on problems and problem solving and initiate both reflection and further dialogue about the subject.

In this issue, we examine types of problem questions, the ABE Math Team's proposed Problem Solving Standard, and approaches to problems as well as provide various interesting problems to pose to students.

We'd do well to remember, though, that ownership of an idea or a problem is important. We are engaged by that which we feel is relevant to us. The real-life problems of our students often provide the best springboard to mathematical exploration. As part of that exploration, it is important to allow both individual and group efforts, for interaction and reflection are each necessary for deep learning.

We hope you enjoy the shared thoughts about problem solving as well as the various news pieces in this issue. And as always, we encourage readers to share their own techniques, responses, perspectives and news with us: Problem Solver, c/oTricia Donovan.

Happy Reading and Holidays!

## *Don't Miss...*

Activity Pages ................. 7-8
Book Corner ................... 12
Field Operations ............. 13
Intersections .................... 14
Perspectives ..................... 2
Points of Interest ............. 4
Q & A ............................. 11
State Lines ....................... 3
Student Segment ............ 10

# Perspectives

## The Argument for Mental Math

by Martha Merson

*A column of practitioner musings. Readers are invited to share their own experiences teaching or learning mathematics, or to respond to this issue's story.*

I usually go to great lengths to avoid an argument, but here I am starting one. I'm taking the position that a few minutes (10-20) of an ABE math class each week are well spent on mental math. The argument goes something like this:

First, much of the math adults are called upon to do is on our feet-produce change, estimate time, calculate the most economical purchase and the only way we are certain whether we are right is if we check ourselves or the situation has built-in feedback;

Second, the word problems (or problems embedded in a situation) we solve in our daily lives are as often communicated orally as they are presented on paper. Picking up verbal cues is as key as decoding written terms;

Third, the short-cuts we invent and the risky problem solving we'd like to see our students attempt is much more likely to occur if pencil and paper are eliminated. Since following traditional steps for double-digit multiplication, addition, or division requires such effort to visualize columns while remembering whole numbers, the push to a more efficient way is a strong one.

Thus, mental math is a realistic form of practice, at least as important as the pencil and paper math.

When Shelley Bourgeois and I spent the beginning of the basic level math class (read multi-level) at Jackson Mann doing mental math, initially students had some difficulty with the vocabulary. After the first few times when Shelley and I saw looks of helplessness and frustration cross faces, we tried harder to build in success. In spite of initial trepidation, we found when we asked students to evaluate the class that the mental math was something they commented on positively. "It keeps you awake." "You can't daydream ...." Another student commented in the same vein, "I like it. It's lively." Clearly mental math captured their attention. Below I list examples of the kinds of problems we posed and what presented the greatest challenges for students.

**What is 10 plus itself?** (What is any number any operation with itself?) This problem called on students to recognize the reflexive pronoun. For both native speakers of English and speakers of English as a second (or third) language, this was difficult. Most, however, grasped the term by the next week and would get any problems with this wording right.

**What is the product of three and two?** For some reason, "product" was a term that people had trouble retaining. We used all the mnemonics we could think of and every time a couple people happily added the numbers. (We asked them to think of rabbits multiplying or (re)producing. We mentioned that sum and add are short words and product and multiply are longer. Does anyone have any other suggestions?)

**Name a fraction that is smaller than 1/2.** Questions like this were ones we threw in depending on the content of the previous lesson. At times we asked students to write a definition of a word like "data" that we had been talking about during the last statistics lesson.

**What number comes next in the series?**
5 10 15 20... or 10 9 8 7 6... or 1 2 3 1 2 3...
Students groaned when we asked these questions. They approached them with no confidence at all. Every time we went over them, we tried to show a mathematical pattern on the board. These futile attempts reminded me of the curves my teachers drew over number lines. What was that about, anyway?

If good ideas deserve credit, the credit is due to Linda Huntington. At the Math Jump-Start Kit overview last summer (1992), she talked about how effective mental math had been with her students. Linda inspired us to try mental math this year. I now know of other teachers who are trying mental math. It's a persuasive argument.

# X-Mania: Reflections on SummerMath '93

Imagine a world, X-Mania, with no number system. Imagine being stranded in this world with three others and a secret message left in the papers of a brilliant woman. There is a number system, she declares, and it has these symbols: A,B,C,D,O.

Among the dead woman's artifacts were several sizes of brown cubes and parallelipipeds left near her list of symbols. The four of you, yourself and three fellow strandees, feel it is urgent and necessary to unlock the dead woman's code.

First you work on counting with the symbols and objects. Then you play with operations, maybe. You work to discover patterns and shortcuts.

After two days of work, you discover that other groups of strandees have been at work on the same problem. Some attacked the problem in ways familiar to you while others viewed the problem from a totally different perspective. Strange, you think.

Who's to say which perspective is correct? The teachers at SummerMath '93 certainly didn't. They presented the X-Mania problem to about 30 teachers from across the nation at the Mt. Holyoke SummerMath for Teachers program, held for two weeks every summer in S. Hadley, MA. They presented the problem, but we, the strandees had to present

*(See X-Mania on page 3)*

# State Lines

By Mary Jane Schmitt, State Bureau of Adult Education

The Massachusetts ABE Math Team, under a National Institute for Literacy grant, has compiled twelve proposed standards which can be used to inform and guide mathematics teaching in adult basic education. The standards were compiled after a year of study, reflection and practice. These twelve standards were adapted from the 1989 NCTM document, Curriculum and Evaluation Standards for School Mathematics. Below are excerpts of the main points of each standard:

### Mathematics as Problem Solving

In the adult basic education classroom, curriculum design must include approaches which allow the learner to:

- explore and employ multiple strategies for solving problems;
- determine, collect, and analyze appropriate data with respect to the original problem or in new problem-solving situations;
- have access to and the ability to use appropriate problem solving tools including the use of calculator, computers, and measurement instruments;
- generalize problem-solving strategies to a wide range of adult-oriented, real-world situations.

### Mathematics as Communication

In the adult basic education classroom, curriculum design must include approaches to teaching mathematics as communication which allow the learner to:

- develop appropriate reading, writing, listening and speaking skills necessary for communicating mathematically in a variety of settings;
- discuss with others, reflect and clarify their own thinking about mathematical outcomes, and make convincing arguments and decisions based on these experiences.
- define everyday, work-related or test-related mathematical situations using concrete, pictorial, graphical or algebraic methods;
- appreciate the value of mathematical language and notation in relation to mathematical ideas.

### Mathematics as Reading

In the adult basic education classroom, curriculum design must include approaches which emphasize mathematical reasoning so that the learner can:

- draw logical conclusions from math situations using concrete models and verbal skills to explain their thinking;
- understand and apply deductive and inductive reasoning, proportional reasoning, with special attention to spatial and visual reasoning with proportions and graphs;
- pose their own mathematical questions and evaluate their own arguments;
- validate their own thinking and intuition, feel confident as math problem solvers, and see that mathematics makes sense.

### Mathematical Connections

In the adult basic education classroom, curriculum design must include approaches to making mathematical connections which allow the learner to:

- view mathematics as an integrated whole that is connected to past learning, the real world, adult life skills, and work-related settings;
- explore problems and describe results using a variety of mathematical models or representations including graphs, concrete, verbal, and algebraic models or representations;
- apply mathematical thinking and modeling to solve problems that arise in other disciplines, and in the

*(See State Lines on page 5)*

## X-Mania

*(Continued from page 2)*

the solutions. And no one made the declaration: This is the right answer.

As a result of the leader's witholding of judgement, we all were better able to analyze and appreciate differences in reasoningand recording methods. Each was free to make her/his own decision about which system or solution was best (after much discussion and reflection, of course, inthe best traditions of SummerMath). Most of us agreed that the most efficient system was best. It was simple, straightforward and more easily operated within.

I can't, however, tell you what the most efficient system was because X-Mania's security is at stake. Maybe you can find three others who'll work out a solution with you, or maybe you'll work on it by yourself. Either way, it would be fun to see your counting system. And remember...you know no numbers!

–Tricia N. Donovan

**The Problem Solver**
Funded by a NIL Grant through SABES
F/HETC, One Arch Place, Greenfield, MA 01301
(413) 774-3182; FAX: (413) 784-1765
Editor - Tricia N. Donovan
Layout - Marie Louise Houle

# Points of Interest...

**Promoted:** Shelly Bourgeois to Director of the Jackson Mann Community School Adult Education Program. Shelly also continues as a Part-time instructor at the school.

**Job Change:** Kenny Tamarkin, formerly an instructor at SCALE, is now a consultant with South Western Publishing.

**Going to Print:** Barbara Goodridge of the Lowell Adult Education Program has been contracted by South Western Publications to co-author a GED math text for their new GED five subject series dueout in '94.

**Call for Articles:** Anyone interested in submitting articles for the National Center on Adult Literacy's publications should contact Iddo Gal, c/o NCAL, Univ. of Penn., Philadelphia, PA 19104-3111.

**Family Math** materials are now available at the Northeast SABES Materials Resource Center, located on the second floor of the Lawrence Public Library.

**The Women's Equity in Education Act** (WEEA) publishing center has a free catalog of classroom books available from WEAA Publishing Center, Inc., 55 Chapel St., Suite 200 Newton, Ma 02160. 1-800-225-3088. The resources offered are inexpensive and gender-fair.

**Name Change:** The Bureau of Adult Education is now known as Adult and Community Learning Services. A reminder that they are now located at 350 Main St., Malden Ma 02148; 617-388-33nO, ext. 353

**Awarded:** Tricia Donovan, GED Instructor, F/HETC, Greenfield was one of two individuals in 1993 to receive the New England Employment and Training Council (NETEC) award for exemplary service.

**Moved:** SABES West Regional Office, to: Room 101A Holyoke Community College.

**Coming Very Soon** Math LO Conference at Landmark College. Call for more information.

**"Improving Math and Science Teaching,"** a publication focused on ways to improve professional development and instructional materials is available for $1.75 from the Superintendent of Documents, U.S. Government Printing Office, Box 371954, Pittsburgh, PA 15250-7954. Stock # 065-000-00553-1.

**"Group Solutions"** a teacher guide with more than 50 logic activities to foster teamwork and collaborative problem solving is available for $15 plus $1.50 shipping from Cynthia Eaton, LHS, Univ. of Cal., Centennial Rd., Berkeley, CA 94720; (510) 642-7771.

**MathWest**, a group of mathematics teachers of all levels, affil-iated with Association of Teachers of Mathematics in New England and the National Council of Teachers of Mathematics, offers various programs throughout the year in Western Mass. They currently have a TWO FOR ONE MEMBERSHIP program. For $15 any two teachers may join MathWest. Write to MathWest, P.O. Box 784, Easthampton, MA 01202-2097 for information.

**Interested in materials** from a teacher education program dedicated to inspiring students, particularly female and minority students, to participate fully in mathematics? Write EQUALS, Lawrence Hall of Science, University of CA, Berkeley, CA 94720; Fax (510) 643-5757; phone 510 642-1910.

**Free Publications** from the Clearinghouse, Division of Adult Education and Literacy, U.S. Dept. of Educ., Washington, DC 20202-7240, FAX 202/205-8973: "It Belongs to Me, A guide to Portfolio Assessment in Adult Education Programs" by Hanna Arlene Fingeret; "Reports of the ABE/ESL Assessment Project" conducted by the Northwest Regional Educational Lab, Wash. State; "ESL Notes," quarterly newsletter devoted to improving ESL instruction.

---

**Have any news for Points of Interest?** Our next issue will be out in the fall, so any workshops or other scheduled event information should be for the Oct. - Jan. period. You can contact The Problem Solver through Math Net, ABE (FHGTC) or contact Tricia Donovan, c/o F/HETC, One Arch Place, Greenfield, MA 01341 (413) 774-3182; FAX: (413) 784-1765.

**Occasional Problems** – Percentages problems for discussion. Submitted by Esther Leonelli from Internet electronic communications. 1. Which would be better: to become 50% richer and then 50% poorer, or to become 50% poorer and then 50% richer, or to have your fortune remain constant? 2. The recipe for pizza in Laurel's Kitchen says: 'Let dough rise only once, about 1 and 1/2 hours'. How long should you let the dough rise if you use Fleischmann's Rapid Rise Yeast, whose package states that it rises 50% faster?

## State Lines

(*Continued from page 3*)

real world, including work-related settings.

### Estimation

In the adult basic education classroom, curriculum design must include approaches to teaching estimation which allow the learner to:

- explore and develop the concepts underlying a variety of estimation techniques and strategies for whole numbers, fractions, decimals, and percents;
- recognize when an estimate is appropriate and useful in real-life situations and the role estimation plays in adult life;
- apply estimation techniques in working with quantities, measurement, computation, problem solving, and in workplace and test situations;
- use estimation to check the reasonableness of results

### Numbers, Operations, and Computation

In the adult basic education classroom, curriculum design must include concrete and developmental approaches to teaching numbers, number relationships, operations, and computation which allow the learner to:

- understand, represent, and use numbers in a variety of equivalent forms and in order relations (integers, fraction, decimal, percent, exponential, and scientific notation) in real-world, work-related, and mathematical problem situations;
- compute with whole numbers, fractions, decimals, and integers, using appropriate algorithms and a variety of techniques including mental math, paper-and-pencil, calculator, and computer methods;
- analyze and explain procedures for computation and understand how arithmetic operations are related to one another, particularly the reversibility of operations;
- use estimation to develop number sense, operation sense, and to check the reasonableness of results.
- analyze and explain methods for solving proportions;
- select and use in problem-solving situations an appropriate method from among mental arithmetic, paper-and-pencil, calculator, and computer methods;
- use computation, estimation, and proportions to solve problems.

### Patterns, Relationships, and Functions

In the adult basic education classroom, curriculum design must include approaches to teaching about patterns, relationships, and functions which allow the learner to:

- explore, recognize, analyze, and extend patterns in mathematical and real-world situations;
- articulate and represent number and data relationships using words, tables, graphs, and rules.
- discover and use patterns and functions to represent and solve problems.

### Algebra

In the adult basic education classroom, curriculum design must include approaches to teaching algebra which allow the learner to:

- represent arithmetic patterns and real-world situations using tables, graphs, verbal rules, equations, and explore the interrelationships of these presentations;
- understand the concepts of and recognize the use of variables, expressions and equations;
- develop confidence in solving equations in one or two variables using concrete, informal, and formal methods;
- apply algebraic methods to solve and represent a variety of test-related, work-specific or real-world mathematical problems.

### Statistics and Probability

In the adult basic education classroom, curriculum design must include approaches to teaching statistics and probability which allow the learner to:

- systematically collect, organize and describe data;
- construct, read and interpret tables, charts and graphs;
- make inferences and convincing arguments that are based on data analysis;
- evaluate arguments that are based on data analysis;
- develop an appreciation for statistical methods as a powerful means for decision making.

### Geometry and Spatial Sense

In the adult basic education classroom, curriculum design must include approaches to teaching geometry and spatial sense which allow the learner to:

- use geometry as a means of describing the physical world relative to all the arts and sciences;
- understand and apply geometric properties and relationships to concrete situations;
- visualize and represent geometric figures with special attention to developing spatial sense;
- identify, describe, compare, and classify geometric figures;
- relate geometric ideas to number and measurement ideas, including the concepts of perimeter, area, volume, angle measure, capacity, weight, and mass;
- explore transformations of geometric figures;
- represent and solve problems using geometric models;
- apply the use of appropriate technologies to the study of geometry and spatial sense.

### Measurement

In the adult basic education classroom, curriculum design must include concrete and experiential approaches to teaching measurement which allow the learner to:

- understand the process and concepts of measurement;

*(See State Lines on page 6)*

# State Lines

*(Continued from page 5)*

- make and use exact and estimated measurements to describe and compare phenomena;
- select appropriate units and tools to measure to the degree of accuracy required in a particular situation;
- understand the structure and use of different systems of measurement.

## EVALUATION

**Alignment:**

In the adult basic education classroom, methods and tasks for assessing students' learning should be aligned with the learner's and the curriculum's:

- goals, objectives, and mathematical content;
- relative emphasis given to various topics and processes and their relationships;
- instructional approaches and activities, including the use of calculators, computers and manipulatives;
- the use of assessment data for purposes other than those intended is inappropriate.

**Multiple Sources of Information:**

Decisions concerning the students' learning should be made on the basis of a convergence of information obtained from a variety of sources. These sources should encompass tasks that:

- demand different kinds of mathematical thinking
- present the same mathematical concept or procedure in different contexts, formats, and problems situations.
- accept and accommodate the wide range of problem solving strategies represented by a diverse learner population;
- allow for the appropriate use of three dimensional materials to show learning;
- involve the use of calculators or computers as tools for demonstrating thinking and problem solving skills;
- include the use of visual, pictorial or graphic representations or models for showing learning;
- promote the use of verbal skills as a means for developing and displaying problem solving strategies.

## PALMS Partnerships—1993-94 School Year

PALMS, Massachusetts' broad based math and science education reform program is entering its second year of activity. Professional development and curriculum frameworks are two of the main foci of PALMS. Below is a list of the adult learning centers participating.

| Sites/School Districts | Adult Education Center |
|---|---|
| Urban Discticts | |
| Boston/East Zone | Haitian MultiService Center |
| Brockton | Brockton Public Schools Adult Learning Center |
| Holyoke | Holyoke Adult Learning Opportunities Center |
| New Bedford | New Bedford Adult Learning Center |
| Springfield | Springfield Public Schools and Onward with Learning Center |
| Worcester | Worcester Adult Learning Center |
| Multi-District Sites | |
| Attleboro-Norton | The Literacy Center and Asult Basic Education Program |
| Central Berkshire Regional School District | Central Berkshire Regional School District |
| Williamstown-Pittsfield | Pittsfield Adult Basic Learning Center |
| Falmouth-Bourne-Mashpee | Falmouth Adult Basic Education-Bourne Adult Basic Education |
| Hampden-Monson Wilbraham | Mass. Audubon Society—Laughing Brook Education Center |
| Lunenburg-Leominster-Fitchburg-School | |
| Union 64/Wachusett Regional School District | Mt. Wachusett Community College |
| Milton-Quincy: | Quincy Adult Education Center |
| North Attleboro-Foxborough-Plainville | North Attleboro Evening Center-Foxborough Evening School |
| Sutton-Framingham-Sturbridge | Framingham Adult E.S.L. Program |

# New Methods With Numbers

## Create-a-Problem

Create-a-Problem is an exercise designed to encourage student communication in the language of mathematics, allow multi-level student invovlement and encourage varied approaches to problem posing and solution. There are unlimited variations possible and at least several good extensions.

1. Have students divide into groups of three or four, preferably four.
2. Give each grup four blank notecards (3x5 work best) and four "clue" cards.

   Sample Clue Cards:

   5 20 tables people

   or

   2/3 1/2 class sheetcake

   (Note: clue cards can reflect the current class math topic or general student learning levels.)
3. Try to have some groups with the same clues.
4. Pass out instruction sheet with the following instructions:

   A Hand out clue cards, one to a person.
   B. Discuss within your group possible ways to use the clues in a word problem. (Set an appropriate time limit.) 1. You must use all the clues in the problem.
   C. Have each group member write a word problem using the clue cards.
   D. Share your individual problems within the group. Discuss the various problems and decide which one you'd like to share with the class and why.
   E. Write up the problem and as many solution methods for it as you can think of in the Create-a-Problem sheet.
   F. You can add new clues. In some cases, you may find you have to.

5. Have all student group problems posted on Create-a Problem Sheets.

   Create-a-Problem Sheet : on large newsprint, etc. write out:

   Clue Words:

   Problem:

   Solution(s):

6. Discuss the various word problems.

   Compare group differences with same clue cards.

   Discuss how problems might be made more verbally or mathematically complex.

   Discuss alternate solutions.

–Tricia N. Donovan

### Group Problem Solving Rules of Order

Barbara Goodridge of the Lowell Adult Education Center did several months of research regarding the use of teams in math class. During her research, she developed two basic rules of order which we find useful:

**Rule 1:** You may not turn in your papers until all members agree to the same answers and understand them.

**Rule 2:** You may not ask the instructor for help or to settle an argument unless all members of the group agree to.

# Why Ask Open-Ended Questions?

A math problem is open-ended if it meets one or more of these three criteria:

1. there is more than one way to solve the problem;
2. there is more than one answer to the problem; or
3. the problem requires the student to interpret the question or to make a value judgement.

These types of questions change the teacher's role from being the absolute authority (the one who has the answer key) to being a facilitator of mathematical exploration. Therefore, solving open-ended problems can be used to build the students' self-confidence. The NCTM Standards urge teachers to encourage their students to develop their own mathematical power and open-ended questions can provide that opportunity.

By asking students to solve open-ended questions and share their solutions in the classroom, four of these standards can be practiced. Students can learn from each other without having to discount their own answers to help them expand their repertoire of problem solving skills. By explaining their answers. students can develop their ability to reason and communicate mathematically. Open-ended questions also frequently ask students to draw on their past mathematical experiences and connect their knowledge in other subject areas to math.

So where can an over-worked ABE teacher find these wonderful open-ended problems? Sorry, you'll have to write them. But it's not impossible and not even too time consuming! For example, you can start with a standard word problem from Number Power 6, p. 2:

7. Jack bought a turkey for $8.34 and a chicken for $4.17. How much did he spend on meat?

(a) $2.00 (b) $4.17 (c) $12.51
(d) $34.78 (e) $20.00

One way to open up this traditional problem is to rewrite the question so that the student starts with what had been "the answer". Then the original problem becomes one of the many possible solutions. For example:

Your budget allows you to spend up to $15.00 for food each week for each family member. Using this week's grocery store fliers, make up your shopping list and calculate exactlv how much YOU would spend.

Asking students to share their solutions to this problem offers the opportunity to connect mathematics to other subjects, nutrition for example. Or other cultures could be explored as students explain to one another the types of meals they prepare. Students will also have the opportunity to connect this problem with the mathematics they use every day. The problem could also be used as an opportunity to develop and connect the students concepts of budgeting to mathematics.

This same trick of posing "the answer" as the question works with all ability levels. Instead of pages of meaningless two digit long division calculation, ask the student to choose from a hat containing 3 or 4-digit numbers to use as the dividend and from the 4-digit numbers hat for the divisor. Then ask the student to write (or tell) a division word problem using those numbers and solve it on a separate paper. When the student exchanges problems with a classmate and solves the other's problem, there is lots of opportunity for expanding the students mathematical communication skills. Or if the class is more advanced ask, "Describe a situation in which you would use ratios to solve a problem." Having students share when they apply various problem solving strategies encourages students to be independent problem solvers and hones their mathematical reasoning skiils.

A word of caution before you jump right in: prepare your students. Explain what an open-ended problem is and why you think it's valuable for your students to be a~le to solve them. The most intriguing open-ended questions will fall flat if the students' derinition of mathematics is rote worksheets. Also remind them that it takes practice. Both the students and the teacher need to get used to their new roles in the math classroom.

–Sally Spencer

BIG BOOK OF STORY PROBS
STORY PROBLEMS
STORY PROBLEMS GALORE
STORY PROBLEMS
MORE STORY PROBS
STORY PROBLEMS
STORY PROBLEMS
STORY PROBLEMS

Hell's library

## Implementing the Standards?

*Many instructors have concerns about some of the changes advocated in the "Massachusetts ABE Math Standards". These concerns are taken seriously by the ABE Standards authors because they've had manuy of the same reservations themselves. Within the next few issues of The Problem Solver, some of these questions, with various authors' responses, will be printed. (The authors are members of the Mass. ABE Math Team.)*

**Q.** "I only have three months to prepare my students for the GED. If I take so much time to do this kind of math, I'll never be able to cover everything! How can I do it?"

**A.** Make "connections." Integrate! Connect math to social studies to science to writing.

**A.** Isn't it better to give students a good solid number sense covering only a few topics rather than give them a little bit of everything that they cannot apply? Sometimes less is more.

**A.** The reality is that learners not only need good (Standards-based) math experiences, but time to develop the thinking skills that will enable them to learn more and better. So...perhaps the problem really reflects the need for teachers to advocate for more realistic time frames for "covering the material" from both programs and students.

**Q.** "What can I do with a whole group where individuals are at different levels?"

**A.** Students learn from each other. To require that they learn individually and independently deprives them of the vast know-ledge and experience that their peers bring to the classroom. Many times a student's peers can explain a problem better than we as instructors can — especially if we never had great difficulty learning math.

**A.** There is no one solution to this problem, but it becomes somewhat easier to think about when you redefine your goals for learners in terms of process (ways of thinking) rather than product (the answer). Standards-based problems and activities encourage students to explore, question and look for patterns.

**A.** Lots! Many exercises can be adapted to meet a variety of learning needs. Open questions, writing their own word problems, discussing various solutions all lend themselves to multi-level classroom use. In addition, the communication between various levels of students broadens everyone's horizons, and students teaching students can be an excellent classroom tool.

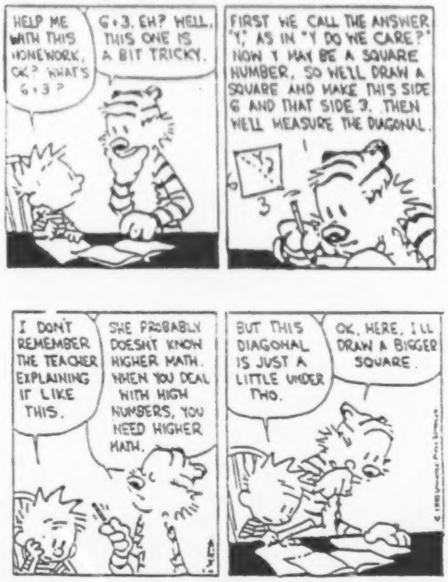
**High Fives** — Using only five fives in any operational combination, write equations for every whole number from 1 to 100. (You can re-use the fives.)

**As The Crow Flies:** You are over Chicago going 500 mph. 45 minutes later, you are over another large city. Where could you be?

**Pick-a-number** — Pick a number between 1 and 50. Add five to the original #. Multiply the sum by two. Subtract four from the product. Divide your answer by two. Subtract your original # from the quotient. Your answer is always 3. Why?

**11/21/1964** Verrazano-Narrows Bridge, longest single span bridge opens. ( 2.03 kilometers)

**Srinivasa Ramanujan,** contributor to theory of numbers and continued fraction was born 11/22/1887.


CALVIN AND HOBBES by Bill Watterson
HELP ME WITH THIS HOMEWORK, OK? WHAT'S 6+3?
6+3, EH? WELL, THIS ONE IS A BIT TRICKY.
FIRST WE CALL THE ANSWER "Y," AS IN "Y DO WE CARE?" NOW Y MAY BE A SQUARE NUMBER, SO WE'LL DRAW A SQUARE AND MAKE THIS SIDE 6 AND THAT SIDE 3. THEN WE'LL MEASURE THE DIAGONAL.
Y?
6
3
I DON'T REMEMBER THE TEACHER EXPLAINING IT LIKE THIS.
SHE PROBABLY DOESN'T KNOW HIGHER MATH. WHEN YOU DEAL WITH HIGH NUMBERS, YOU NEED HIGHER MATH.
BUT THIS DIAGONAL IS JUST A LITTLE UNDER TWO.
OK, HERE, I'LL DRAW A BIGGER SQUARE.

BEST COPY AVAILABLE

# Student Segment

More and more ABE math classes are interacting via electronic mail. Below are a problem presented by a student in **Cathy Coleman's ABE class at the Worcester Adult Learning Center** and some solutions provided by students from **Sally Spencer's class at The Care Center in Holyoke**. All information was transmitted through MathNet on IBM compatible computers. Feel free to share the problem with your own students. See if they derive solutions different than those from The Care Center.

### Martha's "True Life Word Problem"

"My brother bought 48 rolls of toilet paper for $7.50. How much will a package of 4 be? If a package of 4 is usually $1, how much did he save?

### Care Center Solutions

**Here is Aida's solution:**
If 48 rolls costs $ 7.50 and 4 rolls usually is a $1.00, divide $7.50 by 48. The answer is 15 with a reminder of 30. So when you buy 48 rolls for $7.50, it costs .15 cents for each roll. If you multiply .15 cents by 4 the answer is .60 cents. This is the cost for 4 rolls when you buy 48 rolls. Then you subtract .60 cents from $1.00. The answer is .40 cents. So he save .40 cents on each pack of 4 rolls.

**Wendy solved it differently:**
First she divided 48 by 4 = 12. Then she divided 12 into $7.50 = .62 R 7, which averages $.63. Then she multiplied 12 packages of 4 rolls times $1 each = $12.00. From the $12.00 she subtracted the $7.50 sale price and got $4.50 savings.

**Michelle solve it a third way:**
First she divided 48 by 4 = 12. Then she drew a picture of the 48 rolls of TP to see what was going on:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | X | X | X | X | X | X | X | X | X | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | X | X |

So she decided that if she divided $7.50 by 12 she would get the price of each column = .62 6/12. Since 4 rolls (a column) usually costs $1.00, she subtracted the sale price, .63, and got .37 (how much she saved on each column). Then .37 times the 12 columns = $4.44 total savings on 48 rolls.

**Cindy first thought the question was silly:**
$7.50 - $1.00 = $6.50. Then she talked with Michelle to find out why she was doing so much math. Michelle pointed out that it's not fair to compare the cost of 4 rolls with the cost of 18 rolls. Once she understood that, Cindy solved it on her own the way Wendy did.

• • • • • • • • • • • • • • • • • • • • • • • • • • • • • •

Students from **Pat Larsen's ABE class at the North Quabbin Adult Education Center** were concerned about transportation. Their concerns led to factual discoveries and subsequent questions. These questions reflect the real nature of mathematical problems.

The Questions from "Getting Around in Rural Franklin County," a group project done by **Donna Fernet, Sandy Guyer, Diane North, Rose Clough and Bridget Boyce**:

> The Athol and Orange area have a combined population of about 20,000 people. It is the largest population area in the state without public transportation.

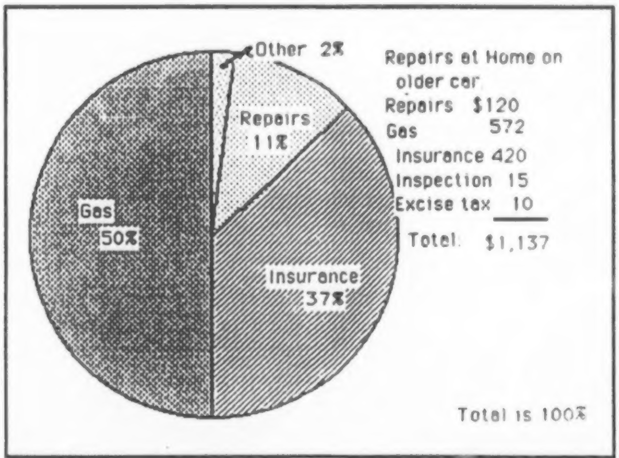
1. How do people get around in this area?

If people don't have a car, there is no way to get around. But some people can't afford cars.

2. How much does it cost to own an older car?

**ANSWERS**
Some Answers to "Getting Around" questions were developed by the group which said, "We talked about these things, collected some information, did some math, and wrote about getting around in our area."

*(See Owning and Running on page 11)*



# Q + A = K(nowledge)

Last issue we discussed the general use of manipulatives in the classroom. This issue we present a specific use for them....

**Q.** Can you suggest ways to teach how to square numbers and find square roots?

**A.** Square root is a relatively isolated computation, often a component of formulas or equations used in advanced science/math courses where either the use of a calculator or reference table quickly supplies the answer; however, neither of these is allowed on the GED test. Still, GED students need to know these computations to make sense of the formula page (area of circle $=\pi r^2$,etc.) and for formulas.

To teach these difficult concepts, the use of manipulatives such as cubes or grids for coloring will help students visualize how a number changes when it is multiplied by itself.

Using a pair of dice, or playing War with 2 sets of cards (using only the cards from ace-6) will actively involve students in practicing and reinforcing the concept of squaring numbers from 1-12. Once students have understood the concept of squaring, a calculator should be available to practice computing the squares of fractions, decimals and numbers large numbers.

Finding the square root of numbers seems to be more difficult for students, perhaps because it's a somewhat reverse operation (as in mult. - div. and add.-sub.). Following a discussion of the meaning of and symbols for square roots, students can practice naming the sq. root of the squares fornumbers 1-12 using 4 sets of teacher-made cards numbered: 1,4,9,16,25,36,49,64,81,100, 121,144, students use the cards to play Fish.

**For example:**

**Student A** (holding five cards): "Do you have $7^2$?

**Student B** (holding 5 cards): "Yes, I have 49. Do you have $2^2$?"

**Student A:** "No. I don't have 4 - Fish."

–Peg Fallon

---

*(Continued from Student Segment page 10)*

## Owning and Running an Older Car

Using the information we collected about car expenses -- What it can cost if you do your own repairs?

| | | |
|---|---|---|
| Gas Costs ..... | $11.00 a week | |
| | Costs per year = 52 x 11 = | $ 572.00 |
| Insurance ..... | Costs per year = | 420.00 |
| Inspection .... | Costs per year = | 15.00 |
| Excise Tax ... | Costs per year = | 10.00 |
| | **Total =** | **$ 1,017.00** |

**Repairs and Maintenance**

Do own repairs on car

| | |
|---|---|
| Costs per year = | $ 120.00 |
| Other costs per year = | 1,017.00 |
| **Total =** | **$ 1,137.00** |

### Figuring the percent for repairs and charting it on a circle graph to see

**1. What percent goes for repairs and maintenance if you do your own repairs?**

$\frac{\$120}{\$1137}$ = _______ x 100 = _________%

**2. What percent goes for gas =?**

$572 = _______ x 100 = _________%

**3. What percent goes for insurance?**

$ 420 = _______ x 100 = _________%

**4. What percent goes for other?**

$ 25 = ______ x 100 = _________%

# The Book Corner

## Meet the Author

*Myrna Manley, author of Contemporary's "The GED Math Problem Solver: Reasoning Skills To Pass the Test," and former GED Testing Service math editor is the subject of the Book Corner's meet-the-author segment ( a new and occasional variation on the usual book reviews contained herein). Ms. Manley presently teaches mathematics at El Camino College in Torrance, CA and is part of the NCTM Task Force on Adult Mathematical Literacy. She served as a consultant to the task force of the American Mathematical Association for Two Year Colleges as they wrote Standards for Curriculum and Pedagogy Reform, and has generously responded to several questions from The Problem Solver.*

### 1. How and why did you start writing?

Actually, I was drafted to write the GED book. After leaving my job as the GED Math Test Editor and talking to various groups of educators of adults around the country, I realized that most GED students were being prepared for the wrong test. For example, the test was not meant to test computational skills, yet this is exactly what the adult math classes were focused on. Since I knew the nature of the test from first-hand experience, teachers were happy to hear my suggestions for GED preparation. As these teachers tried to implement my suggestions, they felt they needed a book, a coherent curriculum that would guide them as they tried to rethink the mathematics that they were teaching as preparation for the test. Thus, I, who had taken math in college because I hated writing all the term papers for other subjects, became an author. It was not a wonderful experience nor a joyous time for me. There was a happy occurrence, however, after I was about halfway through the project. The NCTM Standards were published and I found that the principles I was stressing for adults were in line with those the NCTM was recommending for K-12 mathematics. This was the boost I needed to finish the project with the same ideals with which I had started. Now, in retrospect of couse, it was all worth it: It is thrilling to hear teachers tell me about the difference my book has made to their students.

### 2. and 3. Issues and trends in ABE and GED mathematics

The overwhelming issue is the adaptation of the NCTM standards to the adult basic mathematics field. This Is not an easy task for many reasons. Teachers who are not trained in mathematics are being asked to teach math in a way that will reveal the underlying concepts of the discipline. They are understandably fearful of this; most not being sure they really know the underlying concepts themselves. Teaching the rules of the computation algorithms was easy; teaching so that students become independent problem solvers is not Moreover, much time, effort, and money has been invested in developing the self paced, competency based, individualized learning systems in our learning centers. Can these two approaches co-exist? Can we preserve the best of the past and integrate it with the ideas for the future?

### 4. What trends excite me?

The Massachusetts Math Team excites me. It was really a thrill to hear the results of your research topics at the symposium. Your publications are sure to generate excitement for reform among teachers who have been hesi-tant to try new approaches. Projects such as yours are happening around the country as more teachers become aware that the Standards have a lot to say about adult education as well as K-12. In March, there will be a conference in Washington, DC to bring together the teachers who have begun to rethink their curriculum and practice with the policy-makers who form the regulations under which we work. It is the hope that this coming together will result in more enlightened management which will encourage efforts to improve instruction.

### 5. What advice would you give to would be authors?

Know that you are the experts when it comes to what works in the classroom. You have tried out your ideas and they work with your students. Once you are certain that the mathematics is solid, target your book toward teachers who are like you. Now, of course, every teacher is not like you, nor are their students like yours, so you will not be writing the ultimate compendium that will transcend all others. That's OK. The field needs to have a choice of approaches to teaching mathematics, not more of the same cookie-cutter texts that are presently flooding the market.

**Doppler Effect** — Johann Doppler, born on 11/29/1803, described the Doppler Effect, an important concept in acoustics and optics.

**Geometry and algebra** were linked by Rudolf Clebsch, born on 1/19/1833.

# Field Operations: RABEM Reports
## Part One: What Have We Done?

It's been a long time coming, but now we're going to take this opportunity to share with you some of the things that we've learned about how math is taught in the state. As program administrators or math instructors you may remember taking the time to fill out a very long questionnaire about a year ago. Without further ado, let me thank you for your time. Here's how we ended up response wise:

| Instruments | No. of Responses | No. of Items/Instrument |
|---|---|---|
| Program (Administrator) Questionnaire | 78 | 28 |
| Instructor Questionnaire | 141 | 42 |
| Instructor Interview Guide | 15 | 38 |
| Classroom Observation Guide | 15 x 2 | 28 |
| Learner Interview | 49 (out of 13 classes) | 28 |

I am going to try and share a little bit of information each time the Problem Solver comes out. This time, it will be about what the research was looking at. Basically, we were looking at:

1. Instruction - How Math is being taught.
2. Teachers - Who is teaching math? (what education, training and opinions do they have about math?)
3. Learners - Who is learning math and what do they think about how it is being taught?
4. Content, Curriculum and Materials - What is being taught and what kind of materials are being used to teach it?
5. Program - What do programs do to support math instruction?

**How Much Math Is Taught - or Not... and Why?**

Of the 77 programs that answered the questionnaire, 55 (71 %) offered math classes and 22 (29%) did not. Since it took a second mailing and some phone calls to get programs who don't offer math to fill out the first part of the questionnaire, we think that perhaps the number of programs who don't offer math might be a bit higher. In any case, the reasons programs gave for not offering math were as follows:

| | | | |
|---|---|---|---|
| ESL focus on communication | 54% | ESL students receive math with non ESL students | 18% |
| Not a priority of learners | 27% | | |
| Not a priority of staff | 18% | No need - educational levels of ESL learners very high | 14% |
| Lack of funds | 18% | | |

Other reasons (5%-9%): focus is on learner identified survival skills, math is only used when part of life skills, difficulty explaining math in english, math is not a requirement of state funded ESL programs, there are not enough qualified instructors, we plan to offer math in the future.

And yes, it's true, of the 22 programs who did not offer math, 20 of them were primarily (50%) or exclusively (41 %) ESL - the other 2 were volunteer programs who didn't have the staff or funding to offer math.

**What Math is Taught - and Who Decides?**

Seems that many math classes are taught based on curriculum developed by instructors (41%), groups of instructors (21%) or programs (18%). 25% are chosen by programs and only 4% are selected (from standard published curriculum) by instructors alone. From what we saw and heard, most curricula consist of a collection of things drawn from different published materials kept in libraries and pieced together by instructors based on the needs of learners and content coverage needed.

So until the next issue, keep up the good work, and if any of you have any questions you think I could answer or reactions to what I have shared so far, please feel free to call (413/545-4177) fax (413/545-1263) or write (**Bonnie Mullinix, RABEM/World Education**, 285 Hills House South, University of Massachusetts, Amherst, MA 01003).

# Intersections

## Journals: Doorways to Better Problem Solving

Reflection on the math taught in the classroom is essential for students. By recollecting their experiences with various math activities, their perceptions about and responses to these experiences, students gain a deeper understanding of the lessons taught. They also begin to evaluate processes, algorithms and their own strengths and weaknesses.

Math journals can be used at various times during math class. Students can write in their journals at the end of class or at the end of each segment of a lesson. The journals become a personal record of math learning and a vehicle for student-teacher communication.

The following is a sampling of questions (compiled with help from **Donna Curry**) which can be used to prompt journal writing:

1. What did you learn today and how did you learn it?
2. What "struck" you today (or about this part of the lesson)?
3. Did you learn anything new today?
4. What confuses you still?
5. How might you use in your life what you learned today?
6. What was most helpful to you today in understanding math?
7. When were you most involved in math class today? Least? Why?

The Problem Solver
(SABES Funded)
Tricia N. Donovan
F/HETC
One Arch Place
Greenfield, MA 01301